Reference Manual
IP2030/RM, Rev AA
June 2014

Mobrey MCU900 Series

4–20 mA + HART® Compatible Controller

HART COMMUNICATION PROTOCOL

mobrey

EMERSON™
Process Management

Mobrey MCU900 Series Universal Control Unit

⚠ WARNING

Read this manual before working with the product.

For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For the latest customer support information, visit the Mobrey brand pages at www.emersonprocess.com, and then click on the Mobrey Service or Product Support quick links.

⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact an Emerson Process Management Sales Representative.

⚠ WARNING

Replacement equipment or spare parts not approved by Emerson for use as spare parts could reduce the capabilities of the Mobrey MCU900 Series control unit, and may render the instrument dangerous.

- Use spare parts supplied or sold by Emerson

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Section 1 Introduction

1.1 Safety messages

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a caution symbol (⚠). The external hot surface symbol (⚠) is used when a surface is hot and care must be taken to avoid possible burns. If there is a risk of an electrical shock the (⚠) symbol is used. Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MCU900 Series Control Unit must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

1.2 Manual overview

This manual provides installation, configuration and maintenance information for the Mobrey MCU900 Series control unit.

Section 2: Control Unit Overview

Section 3: Installation

Section 4: Getting started

Section 5: Servicing and Health Checking

Appendix A: Reference Data

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Appendix D: Additional Features

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1.3 Control unit versions and software releases

The following control unit versions are covered in this product manual:

- Mobrey MCU901 Standard Control Unit
- Mobrey MCU902 Differential Control Unit
- Mobrey MCU90F Logging Control Unit

The software release covered in this product manual is issue 4.00.00 (and above).

1.4 Customer support

For the latest customer support information, visit the Mobrey brand pages at www.emersonprocess.com, and then click on the Mobrey Service or Product Support quick links.

1.5 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration. The product and packaging should be disposed of in accordance with local and national legislation.

Section 2 Control Unit Overview

2.1 Safety messages

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a caution symbol (⚠). The external hot surface symbol (⚠) is used when a surface is hot and care must be taken to avoid possible burns. If there is a risk of an electrical shock the (⚠) symbol is used. Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

2.2 About the Mobrey MCU900 Series Control Unit

Note

- A full specification for the control unit is in Appendix A: Reference Data.

2.2.1 Wall and panel mounting options

The **wall mounting** option has a tough, weatherproof enclosure for internal or external installation.

The **panel mounting** option has a black enclosure, and is designed for control room panel or cabinet installation.

Figure 2-1. Mounting options

Wall Mount

Panel Mount

2.2.2 4–20mA HART transmitter input options

4–20mA HART transmitter input options:

- The Mobrey MCU901 Standard control unit and the Mobrey MCU90F Logging control unit accepts **one** 4–20mA or HART transmitter input
- The Mobrey MCU902 Differential control unit accepts **two** HART transmitter inputs

Note

- The Mobrey MCU900 Series is designed for **non-hazardous (safe) area** installation, but can be connected to a transmitter installed in a hazardous area.
  See Appendix B: Product Certifications for the control unit certifications.

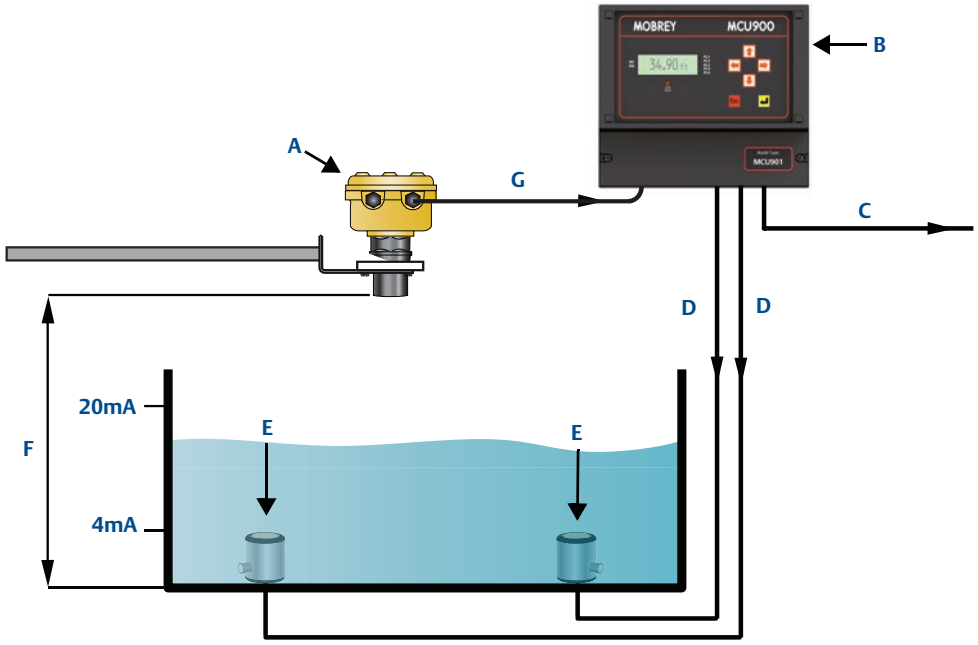
2.2.3 Control functionality

Control functionality is provided by five SPDT voltage-free contact relays in the control unit (see Figure 2-2 on page 4). The five relay outputs are fully field adjustable to perform a wide variety of control, fault indication, or alarm duties.

For applications where the control unit functionality is linked to other external events, there are two digital input ports for accepting contact closure signals.

The isolated 4–20 mA signal output from the Current Output of the control unit is driven by a Primary / Process Value (PV) e.g. level.

Figure 2-2. Typical application using a Mobrey MCU900 Series control unit



A. Mobrey MSP Series Level Transmitter
B. Mobrey MCU900 Series Control Unit
C. 4–20 mA signal output
D. Relay
E. Pump
F. Transmitter Bottom Reference
G. 4–20 mA and HART signal input

2.3 Control unit functions

2.3.1 Standard functions

The Mobrey MCU900 Series control unit provides these standard functions:

- Calculation and display of the control unit **Primary / Process Value (PV)**

  The control unit PV is typically a live transmitter reading, which can be any measured value e.g. level, temperature, or pressure.

  Alternatively, the control unit PV is a volume or flow value calculated using the live transmitter level reading. The control unit is pre-programmed with standard tank shapes and flow algorithms to simplify the configuration for calculating volume or flow from the live transmitter level reading. A 20-point programmable look-up table is provided for non-standard applications.

- Output of measured variable as an isolated 4–20mA signal

  The output signal is driven by the control unit Primary / Process Value (PV).

- Relay control functions

  There are five freely assignable relay outputs. By default, Relay 5 is a fault relay but can be assigned to a control duty. The other relays are available to operate at user-entered PV values.

  The control unit is pre-programmed with popular pump control routines for wet well and sump control, along with energy saving overrides.

- Voltage-free (digital) contact closure inputs

  There are two digital input ports for accepting contact closure signals to override control unit functions.

- HART transmitter interrogation and programming

  Any HART transmitter can be connected. The control unit recognizes the transmitter as an “unknown instrument” but supports the Universal and Common Practice HART commands (see Appendix E: Support for HART® Transmitters).

  When a Mobrey MSP Series HART transmitter is connected, the control unit recognizes the transmitter and allows full access to the transmitter’s configuration parameters. Refer to the reference manual of the transmitter for full information about programming the transmitter parameters (e.g. Transmitter Bottom Reference) using the MCU900 Series control unit or other HART-based devices.

2.3.2 Difference, sum, and product functions (on MCU902 only)

The Mobrey MCU902 Differential control unit has all the functions of the standard control unit, plus extra functions for calculating the difference, sum, or product of two separate inputs from HART transmitters.

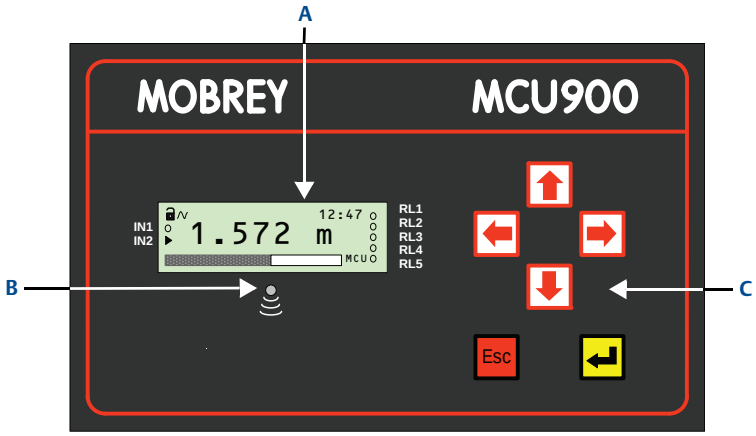
2.3.3 Data logging functions (on MCU90F only)

The Mobrey MCU90F Logging control unit has all the functions of the standard control unit, plus a 7000 event logging function.

2.4 Control unit front panel

This front panel fascia has an integral keypad, display, and health status LED.

Figure 2-3. Front panel fascia



A. 4-line Back-lit LCD Display
B. Status LED
C. Keypad

2.4.1 Keypad

The membrane keypad has six function buttons (Table 2-1). The buttons are used for navigating a menu system and for viewing or changing application parameters.

Table 2-1. Keypad Function Buttons

Button	What the button will do
	When the Primary / Process Value (PV) is shown, use the red (ENTER) button to access the menu system. At other times, this button is for selecting a menu option and for confirming something.
	When navigating the menu system, the UP-ARROW button is for moving upwards one line. At other times, this button is for scrolling through a list of alphanumeric characters or a list of options.
	When navigating the menu system, the DOWN-ARROW button is for moving downwards one line. At other times, this button is for scrolling through a list of alphanumeric characters or a list of options.
	The LEFT-ARROW button is for moving left e.g. to another character when editing a parameter value.
	The RIGHT-ARROW button is for moving right e.g. to another character when editing a parameter value.
	When navigating the menu system, use the ESCAPE button to return to a previous menu level and the Full PV Display. At other times, e.g. while editing, the button is for restoring a setting that is being edited.

2.4.2 Status LED

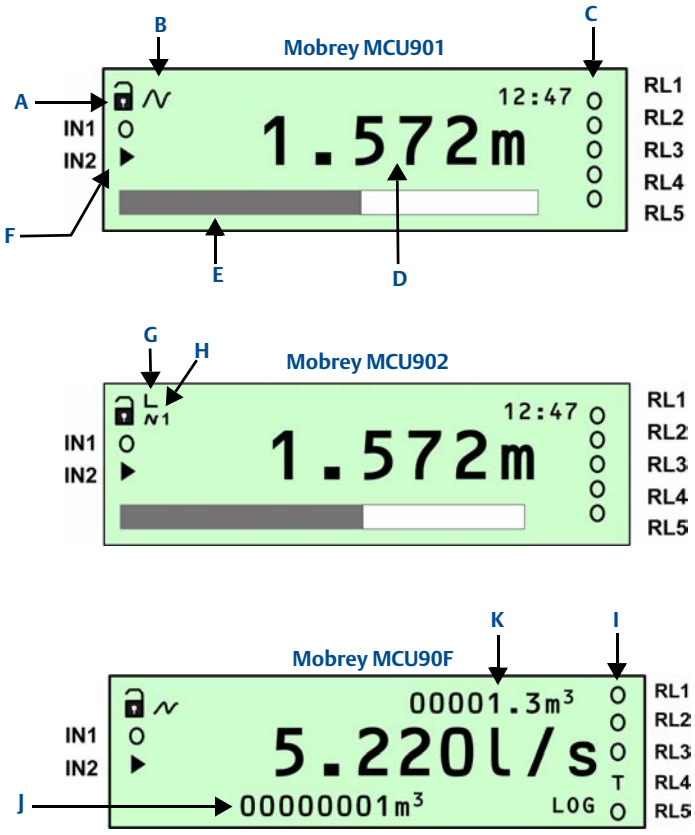
The LED is positioned just below the LCD (Figure 2-3 on page 6). It flashes once per second to indicate that the control unit and transmitters are operating correctly. The LED is constantly lit if there are operating difficulties e.g. a transmitter fault.

2.4.3 Display

After the power-up and self-checks are completed, the **Full PV Display** is presented. The default Full PV Display typically features a digital clock, a measured variable with display units, and status icons. There are some display differences between control units:

- On the MCU901 and MCU902, a bar graph indicates the 4–20mA output signal. (The MCU90F display can be changed to show the bar graph).
- On the MCU902, an extra icon on the first line and indicates if one or two HART transmitters connected to the control unit.
- On the MCU90F, there are two totalizers displayed; one above and one below the control unit Primary / Process Value (PV).

Figure 2-4. Typical displays of the MCU901, MCU902, and MCU90F



A. Program/Run App mode (locked padlock = Run App mode)
B. HART Transmitter Communicating (absent if Idle)
C. Relay (RL) Status: O = De-energized, ▶ = Energized, A = Alarm, S = Sampler, T = Totalizer
D. Primary / Process Value (PV) of Control Unit
E. Bar graph of 4–20mA Output
F. Digital Input Status: O = Open, ▶ = Closed
G. HART Transmitter Allocated: Left Vertical Bar = Tx1; Right Vertical Bar = Tx2
H. HART Transmitter Communicating (1=Tx1, 2=Tx2)
I. Relay (RL) Status: O = De-energized, ▶ = Energized, A = Alarm, S = Sampler, T = Totalizer
J. Totalizer 1
K. Totalizer 2 (Daily Total)

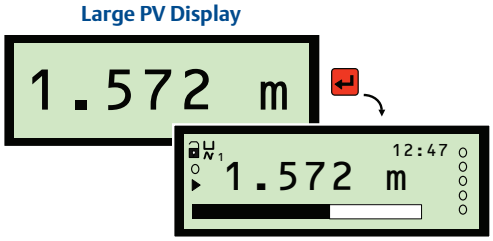
After a period of keypad inactivity, the display automatically changes to the **Large PV Display**. This shows only the control unit Primary / Process Value (PV) and Display units, but in a larger character size to facilitate easier viewing.

To restore the **Full PV Display**, press the red (**ENTER**) button.

Note

- The Large PV Display feature can be switched off using parameter **P574**.
  See "Display configuration options" on page 102.

Figure 2-5. Large PV Display



Section 3 Installation

3.1 Safety messages

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a caution symbol (⚠). The external hot surface symbol (⚠) is used when a surface is hot and care must be taken to avoid possible burns. If there is a risk of an electrical shock the (⚠) symbol is used. Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MCU900 Series control unit must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

3.2 Considerations before installation

Note
The Mobrey MCU900 Series is designed for **non-hazardous (safe) area** installation, but can power and take input from an intrinsically safe transmitter installed in a hazardous area. See Appendix B: Product Certifications for the control unit certifications.

3.2.1 Safety considerations

Guidelines

1. This product is classified type A in accordance with European EMC directive 2004/108/EC. To ensure electro-magnetic compatibility, in any member country, this product should not be installed in a residential area.

2. Do not mount the control unit on a structure that is subject to vibration, or in a position where damage may be caused by impact, thermal stress or liquid ingress.

3. The fuse must only be replaced with the type specified (see page 108 for procedure).

4. If the equipment is likely to come into contact with aggressive substances, it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

   Aggressive Substances - e.g. acidic liquids or gases that may attack metals or solvents that may affect polymeric materials.

   Suitable Precautions - e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

5. The user should not repair this equipment.

6. Terminal 30 (intrinsically safe earth/ground) of the control unit must be connected to a high integrity earth/ground point.

7. A mains powered Control Unit must not be connected to a supply exceeding 250 V r.m.s. or dc, or to apparatus containing a source of voltage exceeding 250 V r.m.s. or dc.

8. A direct current (dc) powered control unit must not be connected to a supply exceeding 30 Vdc or apparatus containing a source of voltage exceeding 30 Vdc.

9. The intrinsically safe outputs of the control unit may be connected to certified equipment used in a hazardous area. Refer to Appendix B: Product Certifications for details of relevant certifications.

10. Cable between the MCU900 Series control unit and a transmitter should be shielded, twisted-pair with the shield connected to terminal 3 (marked with earth symbol) on the MCU900 Series control unit. The shield should be left unconnected at the transmitter unless there is a terminal specifically provided for this purpose.

11. Cable runs should be separate from any high voltage or mains cables to avoid crosstalk or interference.

12. Refer to the technical data in Appendix A: Reference Data.

3.3 Mounting the control unit

3.3.1 Mounting the wall-mount version

Guidelines

- This housing is rated IP65. It is suitable for mounting outside, but this should be above any flood level, away from any overflow path, and away from direct sunlight
- Do not mount the control unit on a structure that is subject to vibration, or in a position where damage may be caused by impact, thermal stress, or liquid ingress
- The mass of the mains powered unit is 1.4 kg, and the DC powered unit is 1.0 kg. To conform with safety requirements, the wall on which the unit is mounted should be capable of supporting four times this weight
- It is not necessary, or advisable, to remove the upper part of the unit housing that contains the LCD and keypad. There are no user serviceable parts inside. The unit must not be modified in any way

Procedure

1. Mount the unit on a suitable wall or structure using the fixing points shown on Figure A-1 on page 121.
2. Make the electrical connections (see "Making electrical connections on wall-mount units" on page 13).

3.3.2 Mounting the panel version

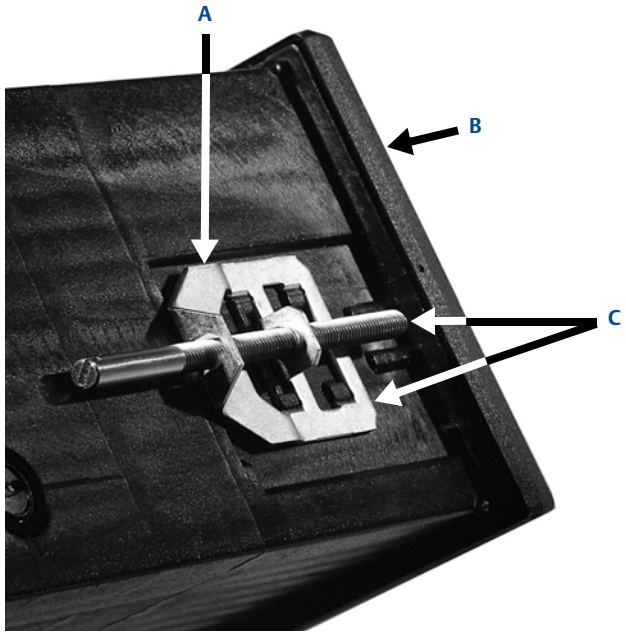
Guidelines

- This housing is rated IP40 and is designed for panel mounting in a weatherproof environment. An optional fascia overlay hood is available which improves the IP rating to IP65 – see Product Data Sheet IP2031 on the Mobrey brand pages at www.emersonprocess.com for ordering information
- Do not mount the control unit on a structure that is subject to vibration, or in a position where damage may be caused by impact, thermal stress, or liquid ingress
- Where three of more units are fitted in the same cabinet or panel, ensure that there is adequate air circulation to aid cooling. It is recommended that an air circulation fan be fitted
- The unit requires at least 6.5 in. (165 mm) clearance behind the mounting panel to avoid cable fouling
- After mounting the control unit, all wiring is made at the rear of the unit using the two part terminal blocks provided. (A pre-wired data download socket suitable for front panel mounting is provided on the MCU90F)
- Mount the control unit on a panel with thickness 1.5 to 10 mm, ensuring the panel is strong enough to support the 2.6 lb. (1.2 kg) weight of the unit
- Ensuring there is enough clearance behind the chosen position in the panel (6.5 in [165 mm] minimum), cut a horizontal slot 5.43 in. (138 mm) long by 2.68 in. (68 mm) high in the panel and remove any rough edges

Procedure

1. Unpack the two **screw clips** provided.
2. Identify the moulded lugs (protrusions) in the recesses on each side of the control unit. (Ignore the recesses on the top and bottom of the unit).
3. Holding the *screwdriver-slot-end* of the **threaded spindle** of one of the screw clamps and looking at the control unit rear, engage a **screw clamp frame** onto the control unit side (see Figure 3-1 on page 12) and see how the four steel lugs (protrusions) of the screw clamp frame engage with the moulded lugs of the unit. Gently pull the screw clamp for the lugs to engage with each other.
4. Remove the *screw clamps* from both of the screw clamp frames.
5. Slide the control unit into the panel, ensuring that the panel seal provided is in place behind the front panel bezel.
6. Re-fit the *screw clamps*, one on each side, and tighten with a screwdriver to clamp the control unit against the panel.
7. For electrical connections,
see "Making electrical connections on panel-mount units" on page 15.

Figure 3-1. The fitted screw clamp



A. Screw Clamp Frame
B. Front Panel Bezel
C. Screw Clamp With Threaded Spindle

3.4 Electrical installation

⚠ WARNING

It is the responsibility of the installer to:

- Refer to safety data and electrical specifications in Appendix A: Reference Data
- Refer to the certifications and control drawings in Appendix B: Product Certifications
- Check and obtain any work permits required before applying power to the unit
- Observe all local regulations and approval requirements
- Ensure the wiring is suitable for the load current
- Ensure the wiring insulation is suitable for the voltage, temperature, and environment of the installation
- Ensure suitable cable glands or conduit connections are used when wiring to the control unit to maintain enclosure integrity

Never remove or modify the mechanical barriers separating the terminal area from the main enclosure and separating the transmitter input terminals from other terminals.

3.4.1 Making electrical connections on wall-mount units

All field wiring connections are accessible by removing the lower terminal cover, which is secured by two screws on the wall-mount control unit.

The cabling between the Mobrey MCU900 Series control unit and a transmitter should be a screened (shielded), twisted-pair type with the cable screen (shield) connected to terminal 3 (marked with earth/ground symbol) on the Mobrey MCU900 Series control unit. The cable screen (shield) should be left unconnected at the transmitter end unless there is a terminal specifically provided for this purpose.

Cable runs should be separate from any high voltage or mains cables to avoid crosstalk or interference.

Figure 3.4.2 on page 15 shows the layout of the control unit terminals. All terminal blocks are suitable for wires 14 to 26 AWG (0,5 to 1,5 mm^2), except the mains terminals which are suitable for wires 10 AWG (2,5 mm^2). Insulation should be stripped back $^1/_4$ in. (7 mm).

Transmitter connections are made on the left side of the terminals enclosure. The intrinsically safe earth/ground (terminal 30) must be connected to a high integrity earth/ground point if the transmitter connected to terminals 1 and 2 is sited in a hazardous area.

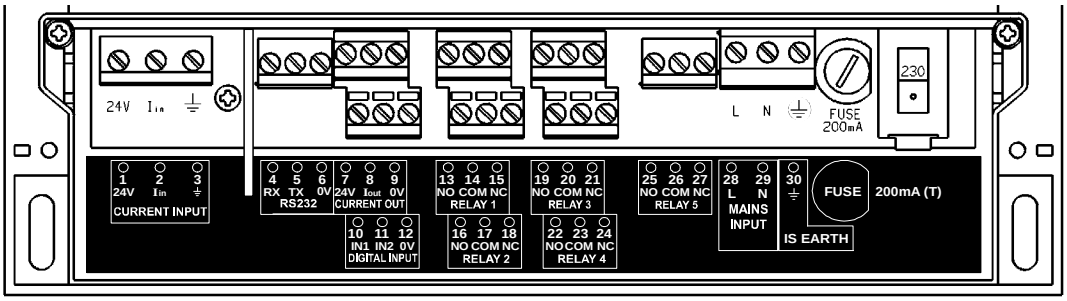
Note

- Use only 167 °F (75 °C) copper conductors for field wiring.

Note

- In intrinsically safe systems, apparatus connected to the MCU900 Series control unit must not be supplied from a voltage greater than 250V r.m.s. or 250 Vdc.

Figure 3-2. Connection terminals layout (for mains-powered wall-mount unit)



(The direct current (dc) powered unit has a slightly different layout – terminals 31 and 32 replace terminals 28 and 29).

Table 3-1. Connection terminal descriptions (for wall-mount unit)

Terminal	Function	Terminal marking
1	Loop supply	24V
2	Current input	Iin
3	Cable screen Earth	(Earth symbol)
4-6	RS232	RX-TX-0V
7-9	Current output	24V-Iout-0V
10-12	Digital input 1 and 2	IN1-IN2-0V
13-15	Relay 1	NO-COM-NC
16-18	Relay 2	NO-COM-NC
19-21	Relay 3	NO-COM-NC
22-24	Relay 4	NO-COM-NC
25-27	Relay 5	NO-COM-NC
28-29 (1)	Mains input	L-N
30	I.S. Earth/Ground	(Earth/Ground symbol)
31 (2)	Negative	-
32 (2)	Positive	+

(1) Mains-powered control unit only.
(2) Direct current (dc) powered control unit only.

Cable glands for the wall-mount unit

The five cable-entry positions are pre-drilled to accept M20 cable glands. The Mobrey MCU90F control unit has a data download socket factory pre-fitted in one of these cable-entry positions.

Two cable glands, rated IP65 and suitable for cable with outside diameter 4 to 7 mm, are supplied for use with the mains supply and transmitter cable. M20 blanking plugs are supplied for the other three cable entry positions.

All glands and blanking plugs are supplied in a plastic bag. The installer must fit these, or suitable equivalents, in place of the transit red-caps, to ensure weatherproofing of the control unit. The white sealing washers supplied with the cable glands and blanking plugs must be fitted on the outside of the enclosure under gland/blanking plug.

3.4.2 Making electrical connections on panel-mount units

Field wiring connections are made to the back of the panel-mount control unit using the two-part (plug/socket) terminal connectors provided. Figure 3-3 shows the rear panel layout.

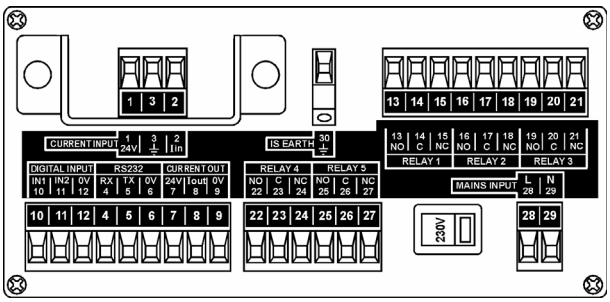
Note

- The plug/socket terminal connectors on the panel mount unit are polarized (keyed) to prevent inter-changeability and incorrect connection.

Cabling between the Mobrey MCU900 Series control unit and a transmitter should be a screened (shielded), twisted-pair type with the cable screen (shield) connected to terminal 3 (marked with earth/ground symbol) on the control unit. The cable screen (shield) should be left unconnected at the transmitter end unless there is a terminal specifically provided for this purpose. Cable runs should be separate from any high voltage or mains cables to avoid crosstalk or interference.

Connect terminal 30 (intrinsically safe earth/ground) to a high integrity earth/ground point if the transmitter connected to terminals 1 and 2 is sited in a hazardous area.

Figure 3-3. Connection terminals layout (for mains-powered panel-mount unit)



(The direct current (dc) powered unit has a slightly different layout – terminals 31 and 32 replace terminals 28 and 29).

Table 3-2. Connection descriptions for panel mount unit

Terminal	Function	Terminal marking
1	Loop supply	24V
2	Current input	Iin
3	Cable screen Earth	(Earth symbol)
4-6	RS232	RX-TX-0V
7-9	Current output	24V-Iout-0V
10-12	Digital input 1 and 2	IN1-IN2-0V
13-15	Relay 1	NO-COM-NC
16-18	Relay 2	NO-COM-NC
19-21	Relay 3	NO-COM-NC
22-24	Relay 4	NO-COM-NC
25-27	Relay 5	NO-COM-NC
28-29 (1)	Mains input	L-N
30	I.S. Earth	(Earth symbol)
31 (2)	Negative	-
32 (2)	Positive	+

(1) Mains-powered control unit only.
(2) Direct current (dc) powered control unit only.

3.4.3 Power connections

When the control unit is powered by mains alternating current (ac) power, select the voltage as 115V or 230V using the voltage-selector slide switch.

When the control unit is direct current (dc) powered, ensure the supply is adequate (15 to 30 Vdc). Do not exceed 30 Vdc.

A switch or circuit breaker should be installed in close proximity to the instrument, and labelled as such. Although the Mobrey MCU900 Series control unit meets all European standards for surge immunity on power and signal lines, it is recommended that lightning suppressors are also fitted if local conditions make this advisable.

3.4.4 Earthing connections

The IP-rated Mobrey MCU900 Series control unit is double insulated and does not require a mains earth.

Do not connect terminal 30 to a mains earth. Terminal 30 is provided for use as an intrinsically safe (or functional) earth connection, which must be used when a transmitter is mounted in a hazardous area and is connected to terminals 1 and 2.

Terminal 3 is to be used for connection of a twisted-pair cable screen (shield) when the control unit is powering the transmitter (see Figure 3-4 on page 17). This screen (shield) should be left unconnected at the transmitter end unless there is a terminal provided for this purpose.

When connected to equipment located in a hazardous area, not meeting the requirements of clause 6.3.12 (Isolation of circuits from earth or frame) in IEC 60079-11:2006 (EN 60079-11:2007), equipotential earthing must be ensured between the equipment and the intrinsically safe earth. An example of equipotential earthing is a cable with a cross-sectional area greater than 4 mm^2 and a resistance of less than 1 ohm.

3.4.5 Transmitter connections and cabling

Connection of a transmitter to the control unit does not confer intrinsic safety on the transmitter. It is the responsibility of the user to ensure any transmitter installed in a hazardous area is suitable for use and certified accordingly. The installation should be in accordance with a recognized code of practice.

Check that the electrical parameters of the installed system of control unit, transmitter, any loop-powered devices, and interconnecting cable to ensure compliance with the product certificates and technical data. Particular attention must be given to the cable and the transmitter to ensure that the total capacitance and inductance limits stated in the technical data in Appendix B: Product Certifications are not exceeded.

Cable joins are allowable in cabling the transmitter, provided that the joint is made within an IP20/NEMA 3 (minimum) enclosure suitable for the environment, and that wiring withstands a test voltage of 500 V r.m.s. to earth.

The maximum length of cable permissible between the transmitter and control unit is determined by limits imposed by the intrinsic safety certificates of the instruments and control drawings.

No other outputs from the control unit must be routed through a hazardous area unless protected by an additional I.S. Barrier (not supplied).

It is the responsibility of the user to ensure that any transmitter is installed in accordance with the manufacturer's instructions supplied with the transmitter.

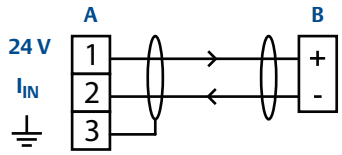
Cable between the MCU900 Series control unit and a transmitter should be shielded twisted-pair with the shield connected to terminal 3 (marked with earth symbol) on the MCU900 Series control unit. The shield should be left unconnected at the transmitter *unless* there is a terminal specifically provided for this purpose.

Cable runs should be separate from any high voltage or mains cables to avoid crosstalk or interference. Multi-core cable may be used if the other cores carry only low voltage (24 Vdc nominal) signals and each pair of cores is individually screened (shielded).

Loop-powered transmitters must be connected to terminals 1, 2, and 3 on the control unit (see Figure 3-4).

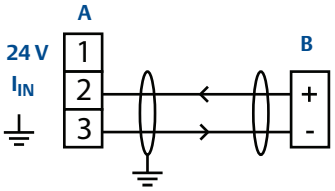
The MCU900 Series control unit supplies 23 Vdc from a 400 Ohm source to power transmitters. Separately powered transmitters must be connected to terminals 2 and 3 (see Figure 3-5).

Figure 3-4. Loop-powered transmitter connections to MCU900 Series control unit



A. Control unit
B. Transmitter

Figure 3-5. Self-powered transmitter connections to MCU900 Series control unit



A. Control unit
B. Transmitter

3.4.6 Connecting HART transmitters to the Mobrey MCU902

The Mobrey MCU902 control unit takes the input from two HART transmitters and calculates the sum, difference, or product of the two inputs.

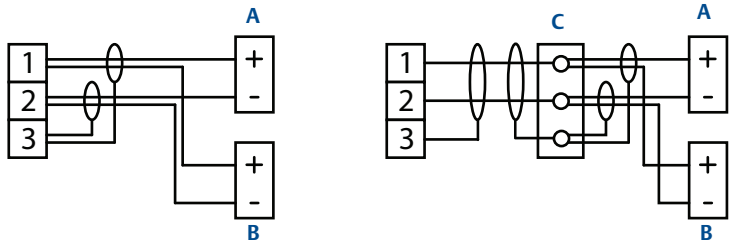
Note

- The transmitters must be HART compatible for the MCU902 to operate correctly.

Connection of the two transmitters to the MCU902 can be done by:

- cabling both transmitter cables wired directly into Current Input terminals on the MCU902 (Figure 3-6), or
- using a single cable wired directly into Current Input terminals with the two transmitters connected to this single cable via a suitable junction box (Figure 3-6).

Figure 3-6. Connecting two HART transmitters to the Mobrey MCU902



A. HART Transmitter Tx1
B. HART Transmitter Tx2
C. Junction box

For correct operation, each HART transmitter must be changed to “multi-drop” mode to allow them to communicate with the Mobrey MCU902 control unit through a common connection. Each HART transmitter must therefore have their **poll address** changed from the factory default address of “0” to a unique address.

The MCU902 control unit is used to achieve this address change, but requires the transmitters to be connected in a specific sequence as detailed here:

1. With the power supply turned off, connect the first HART transmitter to the Current Input terminals on the MCU902 control unit (see Figure 3-6).

2. **Check the voltage-selector-switch** is set for the correct voltage on the mains-powered control unit (115 or 230 Vac), and then turn the power on.

3. After applying power, the control unit searches for a **HART transmitter**.

   A HART transmitter with the factory default polling address of 0 is found after 15 seconds. The control unit automatically changes the Transmitter Poll Address from “0” to “1” and it is designated “**Tx1**” (Transmitter 1) and assigned to **Channel 1**.

   The control unit reads parameters from the HART transmitter and makes them available for local interrogation and programming within the menu system.

4. When an un-configured Mobrey MSP Series Level Transmitter is being used for the first time, a prompt appears asking for the **Transmitter [1] Bottom Reference**.

   If commissioning the system now, edit and save a new Transmitter Bottom Reference or keep the existing Transmitter Bottom Reference. After the start-up process is complete, the display appears showing a measurement e.g. liquid level or the menu system.

   If the system is not to be commissioned at this time, simply switch off the power and the same prompt re-appears when switching on the power next time. The Transmitter Bottom Reference can be changed later, but it is better to get it correct now.

Note

- If the Re-connecting to Digital Transmitter message does not appear, check that the operating mode of the control unit is set to **Run App** mode (see page 38) and that the Input Channel Source is set for a **digital HART input** (see page 48 or page 50)

5. Turn the power supply off and connect the *second* HART transmitter (see Figure 3-6), such that both HART transmitters are connected at the same time.

6. Turn the power supply on.

7. The MCU902 control unit searches for, and detects, the two connected HART transmitters.

   After the second HART transmitter is found, the control unit automatically changes the Transmitter Poll Address from “0” to “2” and it is designated “**Tx2**” (Transmitter 2) and assigned to **Channel 2**.

   The control unit reads parameters from the HART transmitter and makes them available for local interrogation and programming within the menu system.

8. When an un-configured Mobrey MSP Series Level Transmitter is being used for the first time, a prompt appears asking for the **Transmitter [2] Bottom Reference**.

   If commissioning the system now, edit and save a new Transmitter Bottom Reference or keep the existing Transmitter Bottom Reference. After the start-up process is complete, the display appears showing a measurement e.g. liquid level or the menu system.

   If the system is not to be commissioned at this time, simply switch off the power and the same prompt re-appears when switching on the power next time. The Transmitter Bottom Reference can be changed later, but it is better to get it correct now.

9. The two HART transmitters are now known to the control unit, and will be remembered each time the power is switched off and on.

3.4.7 Relay connections

The five voltage-free contact relays are grouped as shown in Table 3-3. Whilst each relay is individually double-insulated, their arrangement is such that the insulation between relays in the same group is standard or 'basic' insulation. **Care must be taken in order to avoid the risk of electric shock**. It is allowed to use relays in the *same group* to control circuits with both mains and dc, or low voltage circuits.

Note

- The relay labels (NO-C-NC) in Table 3-1 and Table 3-2 represent the relay terminals in the de-energized state.

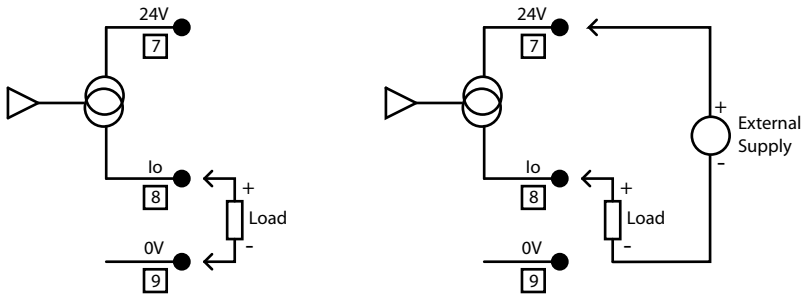
Table 3-3. Relay configuration groups

Wall Mount MCU900 Series control unit	Panel Mount MCU900 Series control unit
Relay 1 and 2: Group 1	Relay 1, 2 and 3 : Group 1
Relay 3 and 4 : Group 2	Relay 4 and 5 : Group 2
Relay 5: Group 3	

3.4.8 Current output connections

The Current Output may be connected in *internally-powered* or *loop-powered* mode, as shown in Figure 3-7. In loop-powered mode, an external power source is required. A minimum of 2.5 V dc is required across terminals 7 and 8 for correct operation. The voltage must not exceed 30 Vdc.

Figure 3-7. Alternative output current configurations

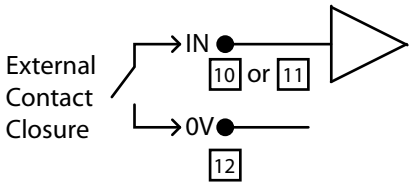


Internally Powered **Loop Powered**

3.4.9 Digital control voltage-free contact inputs

There are two trigger inputs, **IN1** and **IN2**. Each input is connected as shown in Figure 3-8.

Figure 3-8. Connections for external trigger input



3.4.10 RS232 connections

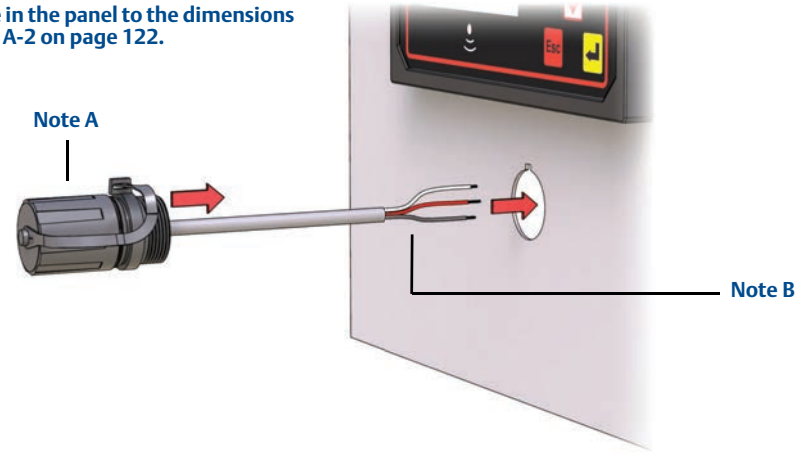
The RS232 connections, terminals 4, 5 and 6, are for downloading logged data to a PC or a handheld device.

- Wall-mountable Mobrey MCU90F control units are supplied with a factory pre-fitted RS232 data-download socket, which is also pre-wired to terminals 4, 5, and 6.
- The panel-mountable Mobrey MCU90F control unit is supplied with a data-download socket ready to be fitted to a panel (see Figure 3-9 on page 22) and then wired to terminals 4, 5, and 6 on the rear of the control unit (see Figure 3-10 on page 23).

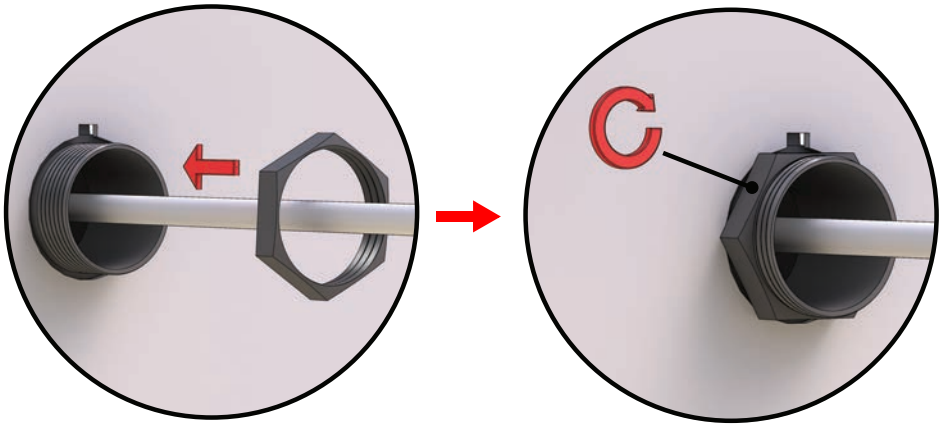
When there is data to be downloaded using Mobrey LOG-VIEW or other software, connect the RS232 data-download cable supplied with the socket (see Figure 3-11 on page 23).

Figure 3-9. Fitting the RS232 data-download socket to a panel

Cut-out the hole in the panel to the dimensions shown in Figure A-2 on page 122.



Use the supplied mini-B nut to secure the socket to the panel.



A. RS232 socket with cap fitted.
B. RS232 socket flying lead.

Figure 3-10. Wiring the socket flying lead to terminals 4, 5, and 6 (panel mount unit)

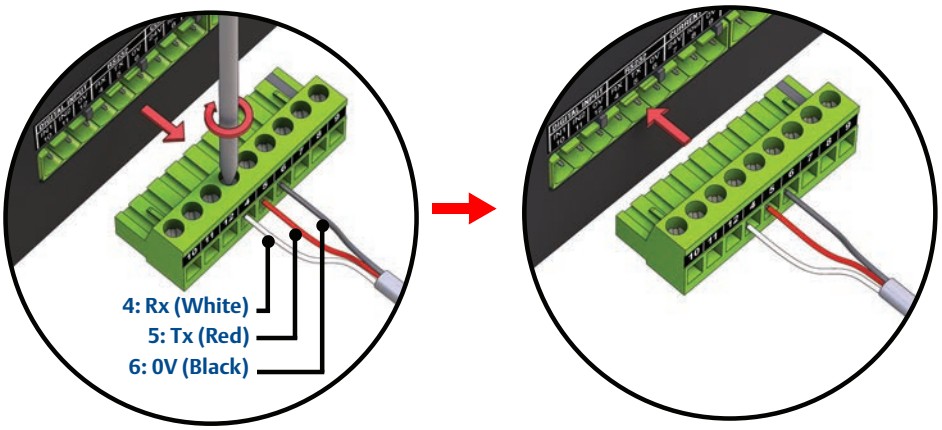
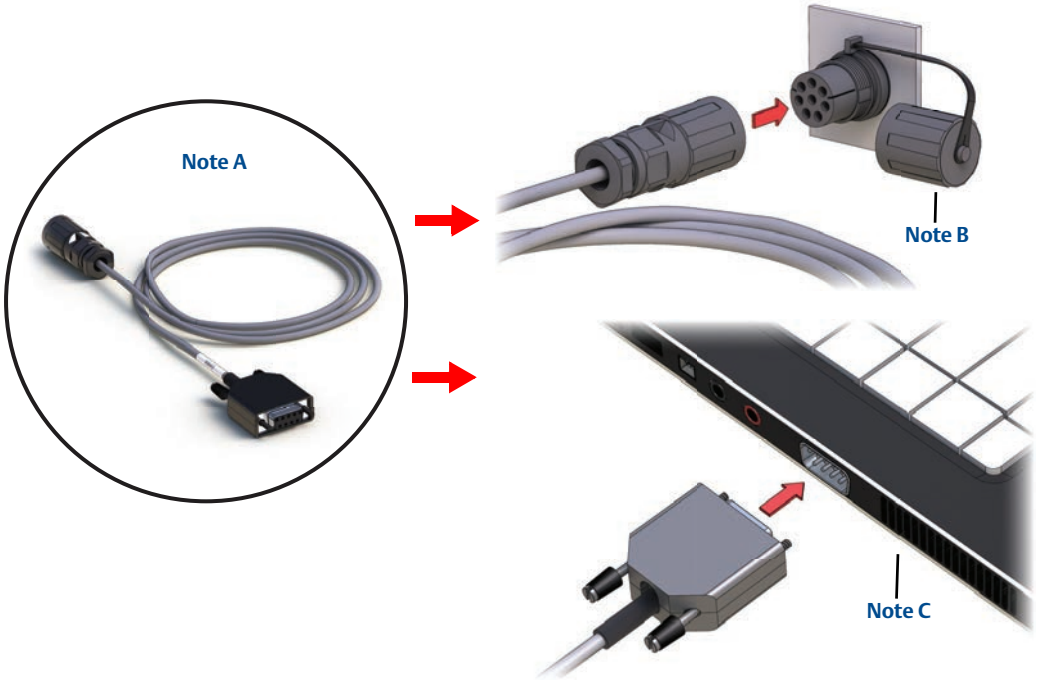


Figure 3-11. Connecting the RS232 data-download cable supplied with the socket



A. RS232 data-download cable.
B. Unscrewed socket cap.
C. See Mobrey LOG-VIEW manual IP130 for further information on downloading logged data.

Section 4 Getting started

4.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the safety messages listed at the beginning of each section before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MCU900 Series control unit must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

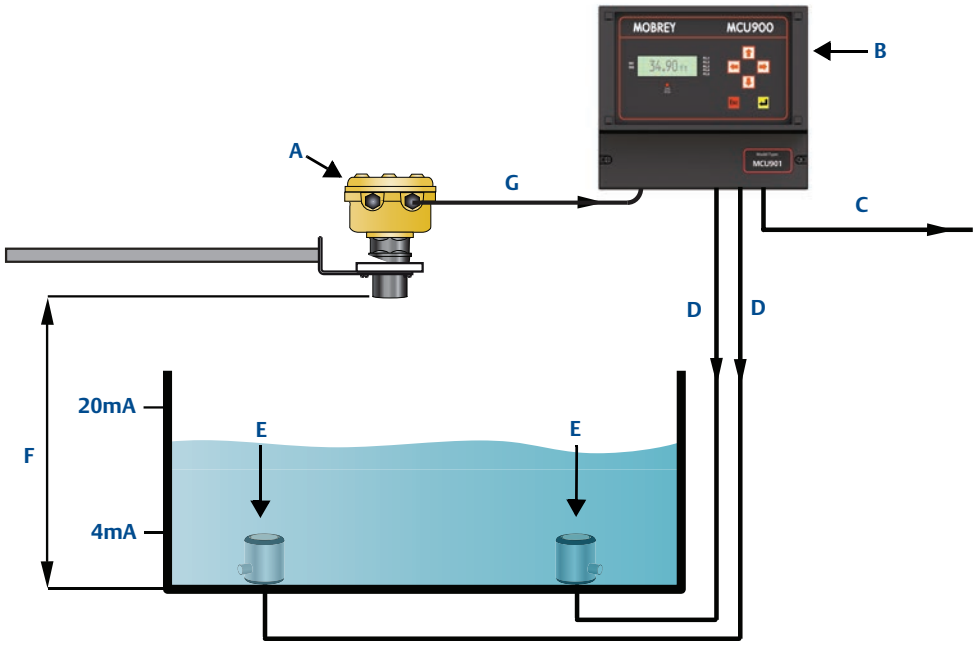
Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

4.2 Switching on the MCU901 and MCU90F for the first time

The Mobrey MCU901 and MCU90F control units accept the input from a single HART or 4–20 mA transmitter. Connect the transmitter to the **Current Input** terminals on the control unit as explained in the section "Electrical installation" on page 13.

Figure 4-1. The Mobrey MCU901 or MCU90F control unit with one transmitter

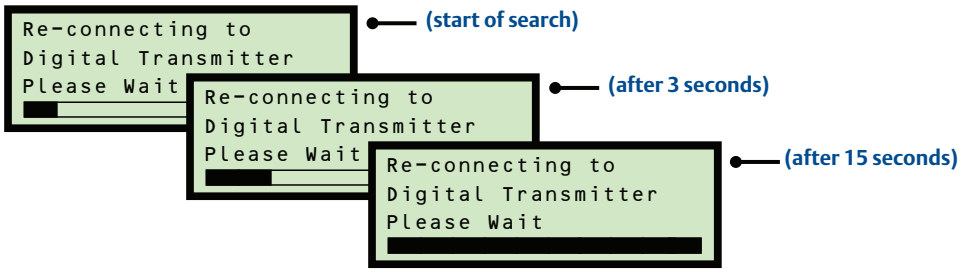


A. Mobrey MSP Series Transmitter
B. Mobrey MCU900 Series Control Unit
C. 4–20 mA signal output
D. Relay
E. Pump
F. Transmitter Bottom Reference
G. 4–20 mA and HART signal input

4.2.1 Switching on with one new HART transmitter connected

After applying power, the control unit first displays the control unit version e.g. MCU901 and the software version. It then automatically searches for a **HART transmitter**.

Figure 4-2. Searching for a HART transmitter after applying power



A HART transmitter with the factory default polling address of 0 is found after 15 seconds. When found by the controller, it is designated "**Tx1**" (Transmitter 1) and assigned to **Channel 1**.

However, if the polling address is in the range 1 to 15, a prompt appears allowing the polling address and the tag name to be changed. This is optional, and pressing the **red (ENTER)** button continues the start-up process.

At this time, the control unit reads parameters from the HART transmitter and makes them available for local interrogation and programming within the menu system of the control unit.

When an un-configured Mobrey MSP Series Level Transmitter is being used for the first time, a prompt appears asking for the **Transmitter Bottom Reference** (Figure 4-3). This value is used to automatically set-up the 4–20 mA output span of the transmitter over this range.

If the system is not to be commissioned at this time, simply switch off the power and the same prompt re-appears when switching on the power next time. The Transmitter Bottom Reference can be changed later, but it is better to get it correct now.

If commissioning the system now, edit and save a new Transmitter Bottom Reference or keep (save) the existing Transmitter Bottom Reference (Figure 4-3).

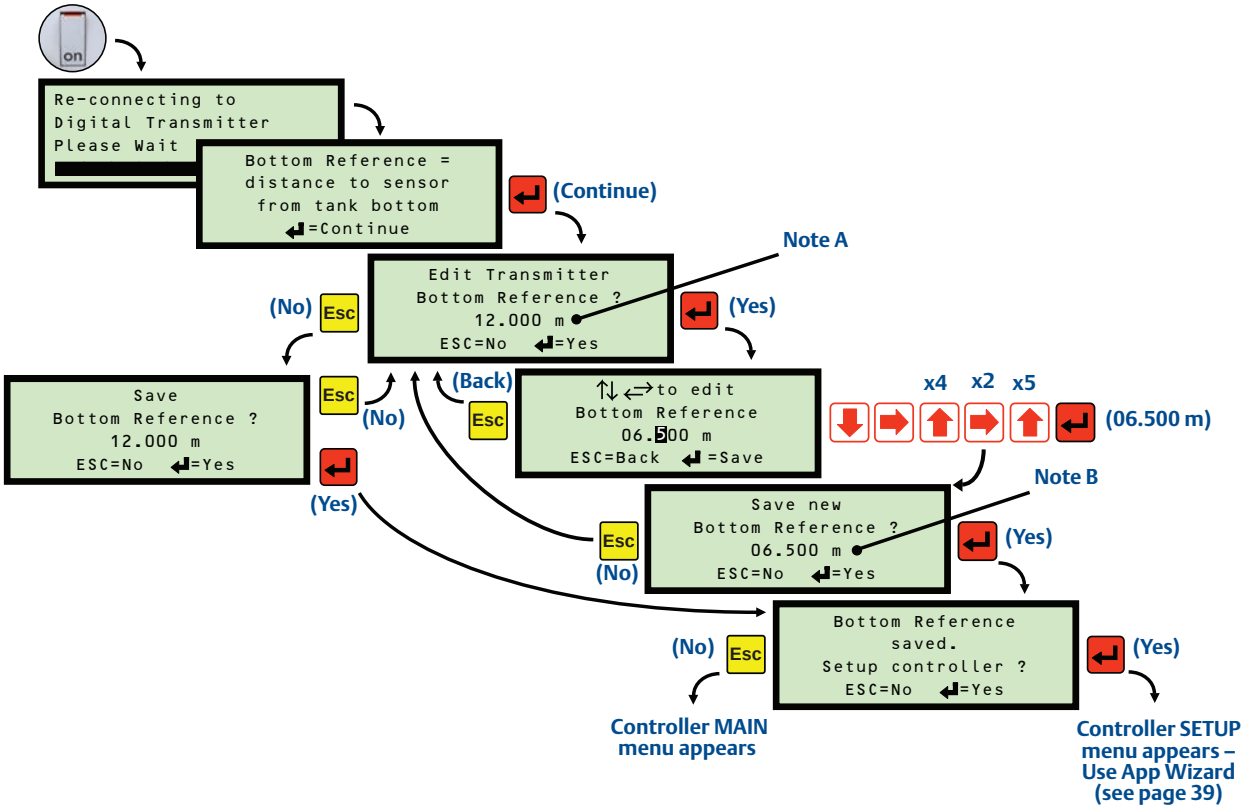
Note

- If the Re-connecting to Digital Transmitter message does not appear, check that the operating mode of the control unit is set to **Run App** mode (see page 38) and that the Input Channel Source is set for a **digital HART input** (see page 48 or page 50)

After the start-up process is complete, the display appears showing a measurement e.g. liquid level or the menu system. The value on the display is the Primary / Process Variable (PV) of the control unit, but this can be changed (see "Display configuration options" on page 102).

Whenever power is lost and restored, the control unit re-establishes digital communications with the HART transmitter and the PV display re-appears.

Figure 4-3. Prompts for Transmitter Bottom Reference



A. Default Bottom Reference as read from a Mobrey MSP900FH Transmitter configured with metric base units. Example is for illustration only.
B. The 6.500 m has been used here as an example new bottom reference. Enter the value that is required for your level measurement.

4.2.2 Switching on with one 4–20 mA transmitter connected

After applying power with a **4–20 mA transmitter** connected, the Full PV Display appears and indicates a control unit Primary / Process Value (PV) of zero. It is then necessary to configure the control unit for a 4–20 mA input instead of a digital HART input.

See "Optional change: transmitter input channel settings (advanced users)" on page 43 for this procedure.

4.3 Switching on the MCU902 for the first time

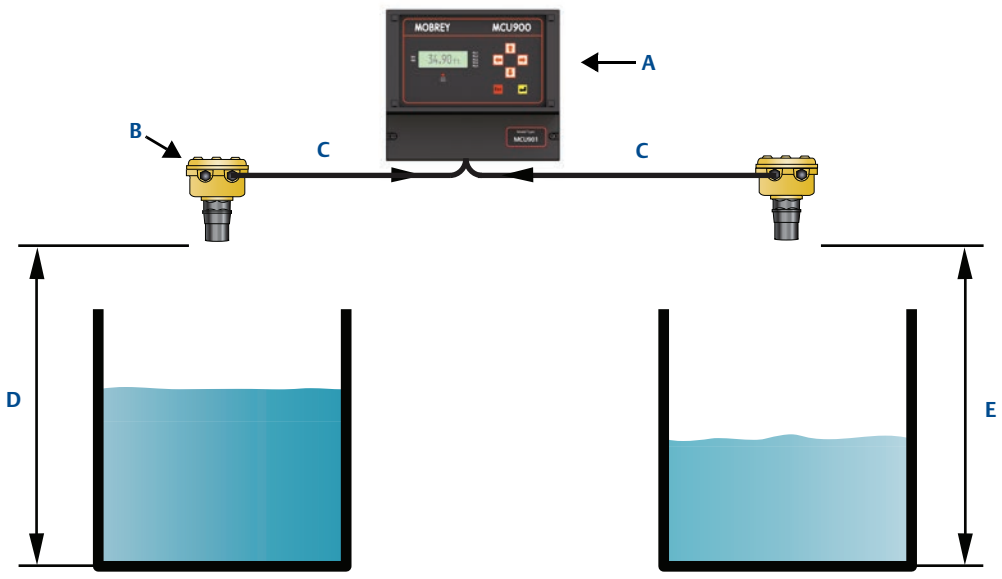
The Mobrey MCU902 takes the input from two HART transmitters and calculates a single sum, difference, or product of the two inputs.

It is important to connect the two HART transmitters in the *correct sequence*, as detailed in "Connecting HART transmitters to the Mobrey MCU902" on page 18.

After both HART transmitters are connected, the top-left corner shows communications with both transmitters by alternating "1" and "2" next to the digital communications icon.

The factory default configuration shows the reading from the first connected transmitter (Tx1). This configuration can be changed to show the sum, difference or product of the readings from both transmitters.

Figure 4-4. The MCU902 and two HART transmitters



A. Mobrey MCU900 Series Control Unit
B. Mobrey MSP Series Transmitter
C. HART Communications
D. Transmitter [1] Bottom Reference
E. Transmitter [2] Bottom Reference

4.4 A quick tour of the menu system

Follow these instructions for a quick tour of the menu system:

1. This quick tour begins at the **Full Display** or **Large PV Display** (Figure 4-5 on page 31).

   *If already within the menu system, use the **Esc** button repeatedly until the Full Display re-appears*.

2. Press the **red (ENTER)** button to display the MAIN MENU (see Figure 4-5 on page 31).

   The MAIN MENU is the top level of the menu system.

3. Navigation of the menu system is achieved by using the **ARROW** buttons, the **red (ENTER)** button, and the **Esc** button.

   *The **Esc** button returns you to the previous menu level, unless you are at the top level.*

4. The highlighted and blinking text indicates what menu option will be selected if the **red (ENTER) button** was pressed now. Do not press it yet.

5. The ↓ symbol on the display indicates there are further menu options available, accessible by using the **DOWN-ARROW** button.

   An ↑ symbol indicates there are further menu options available, accessible by using the **UP-ARROW** button.

6. The MAIN MENU sits above a series of sub-menus, which lead to further levels of sub-menus that lead to parameter screens (see Figure 4-6 on page 31).

7. Press the **red (ENTER)** button to select the highlighted menu option **SETUP**.

8. The **SELECT INSTRUMENT** menu now appears. This screen is for selecting whether to enter the setup menu for the control unit (controller) or a found HART transmitter.

   If there are no HART transmitters connected, Step 7 results in the SETUP menu for the control unit appearing straight away. Skip to Step 10.

9. Press the **red (ENTER)** button to select the highlighted menu option **Controller:** * * * *.

10. The control unit **SETUP** menu now appears with menu options **APPLICATION**, **DISPLAY**, and **OUTPUT** visible.

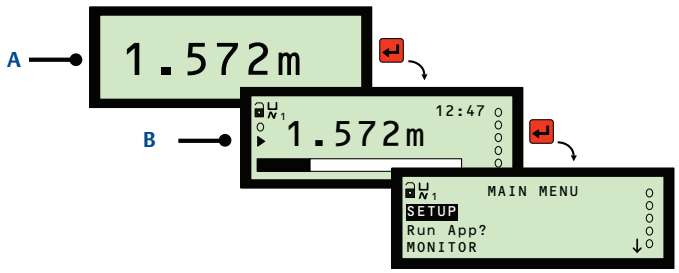
11. Use the **DOWN-ARROW** button to highlight **OUTPUT** and then press the **red (ENTER)** button to select and enter the **OUTPUT** menu.

12. The **OUTPUT** menu now appears with menu options **CURRENT OUTPUT**, **RELAY**, **TOTALIZER**, **PV DAMPING**, **ALARM**, and **FAULT**.

13. Explore these menu options to see screens for setting-up for an application and for displaying read-only information.

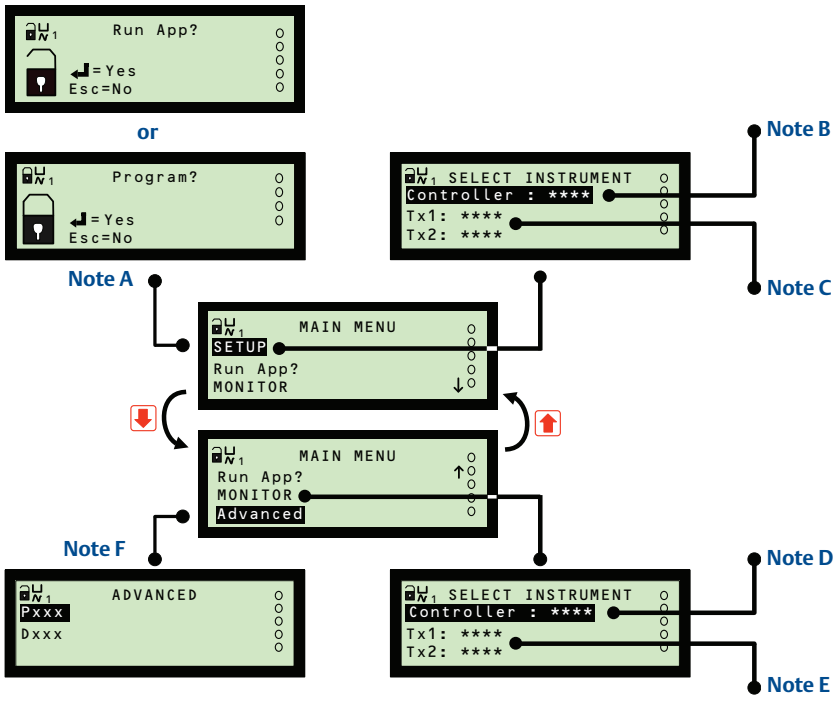
14. After exploring, hold down the **Esc** button once to return to the MAIN MENU.

Figure 4-5. How to enter the menu system



A. Large PV display.
B. Full display showing PV in normal size characters and other information.

Figure 4-6. MAIN MENU overview



A. Toggles the operating mode of the control unit. An open padlock indicates that Program mode is selected and parameter values can be changed.
B. Selecting Controller: ****leads to the SETUP menu for setting up the control unit for an application.
C. Selecting Tx1: **** leads to the SETUP menu for adjusting the HART transmitter Tx1 operation (and similarly for Tx2 on the Mobrey MCU902). The Transmitter Bottom Reference for Tx1 (and similarly for Tx2) can be changed here.
D. Selecting Controller: **** leads to menus for viewing live readings and diagnostic information for the control unit.
E. Selecting Tx1: **** leads to menus for viewing live readings and diagnostic information from the HART transmitter Tx1 (and similarly for Tx2 on the Mobrey MCU902).
F. Advanced access menu for advanced users to directly select parameter screens when the parameter number is known. For a guide to this, see Appendix D Additional Features.

4.5 Programming the control unit

4.5.1 The basics

This chapter covers programming using the front panel of the MCU900 Series control unit to make changes to the factory default set-up of the control unit.

Use the Application Wizard (App Wizard) to easily set-up the control unit for a level, flow, or contents volume application, and then optionally adjust the set-up by editing parameters in the menu system. See Appendix C: Menus and Parameters for a full list of menus and parameters.

Note

- If a Mobrey MSP Series transmitter is connected, refer to the reference manual of the transmitter for full information about programming the transmitter parameters (e.g. Transmitter Bottom Reference) using the MCU900 Series control unit or other HART-based devices.
- For information about how the control unit supports other HART transmitters, see Appendix C: Menus and Parameters and Appendix E: Support for HART® Transmitters.

The basics about parameters

The MCU900 Series control unit has menu-based parameters for programming – setting up for an application, adjusting default settings, etc. – and for viewing information.

Parameters are populated throughout the menu system. They are grouped in sub-menus, which are organized for intuitive programming. Each parameter has a unique 3-digit identification number, prefixed by a 'P' (if programmable) or a 'D' (if for display purposes only).

Note

- A full list of menus and parameters is in Appendix C: Menus and Parameters

With some experience, it becomes easy to locate parameters. Alternatively, parameters can be accessed directly by entering their unique 3-digit identification number. Details of this Advanced access feature are in Appendix D: Additional Features.

To understand the basics about editing a parameter setting, follow the worked examples for editing a **numerical parameter** and the **calendar date parameter.**

How to edit a numerical parameter

1. Navigate to the **Up Range Value** parameter screen (see Figure 4-7).
2. When entering any parameter screen, it is in **View Mode** (Figure 4-8 on page 34). Help with what can be done next is on display line 4.

   *(In View Mode, the **Esc** button is used to leave (quit) the parameter screen. The **SETTINGS** menu then re-appears, as seen before selecting the parameter screen).*
3. To enter **Edit Mode**, press the **red (ENTER)**.
4. A highlighted **"+"** appears (Figure 4-8) to show this positive sign can be changed to be a negative sign. The **UP-ARROW** or **DOWN-ARROW** cycles between **"+"** and **"–"**.

   *(Also, note that on display line 4, "**Edit**" has changed to be "**Save**").*
5. Change the number from **"+12.000"** to **"+6.500"** (Figure 4-8):
   a. Press the **RIGHT-ARROW** button once to move right one space and highlight the **"1"**.

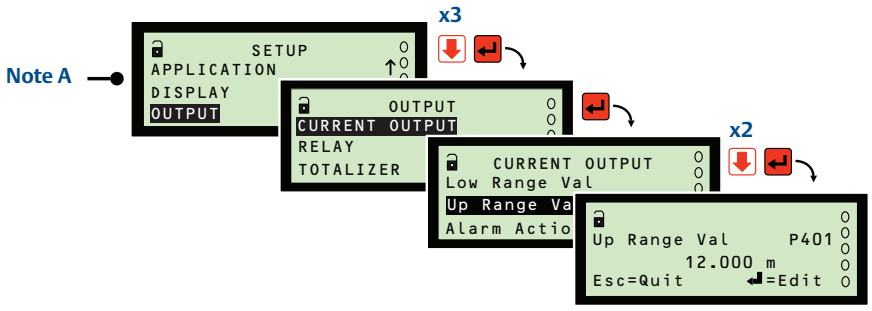
      *(The **LEFT-ARROW** can be used to move the highlight back one space).*
   b. Press the **UP-ARROW** button five times to change the **"1"** to a **"6"**.

      *(The **DOWN-ARROW** can be used to scroll down through the numbers and decimal point).*
   c. Press the **RIGHT-ARROW** button once to highlight the **"2".**
   d. Press the **DOWN-ARROW** button three times to change the **"2"** to a **decimal point**.
   e. Press the **RIGHT-ARROW** button once to highlight the **old decimal point**.
   f. Press the **DOWN-ARROW** button six times to change the **old decimal point** to a **"5"**.

      (Note that other button press sequences could have been used to edit 6.500).
6. Press the **red (ENTER)** button to save the **+6.500** and return to **View Mode**.

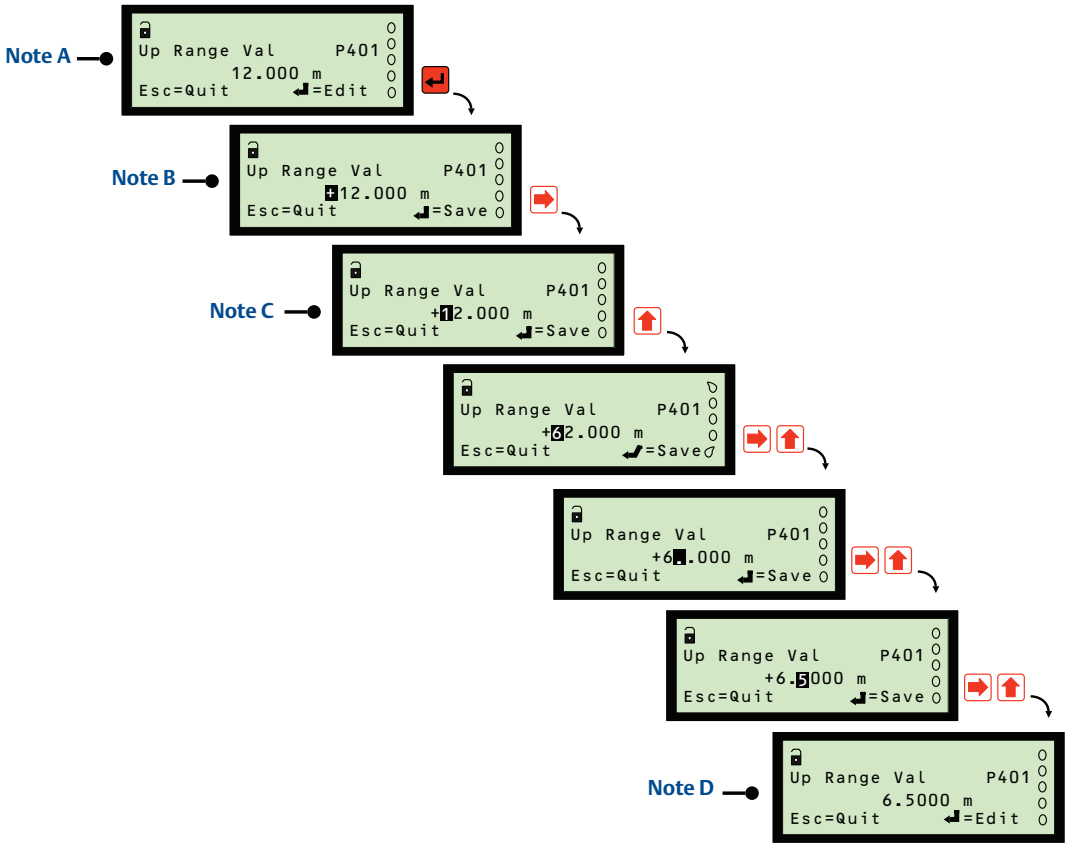
   *(Note that on display line 4, "**Save**" has changed back to "**Edit**").*
7. Press the **Esc** button to return to the **SETTINGS** menu.

Figure 4-7. Navigation to a numerical parameter screen



A. This is the SETUP menu for the control unit – see Figure 4-6 on page 31 for how to get here.

Figure 4-8. Example of editing a numerical value



A. When entering any parameter screen, it is in View Mode. Help with what can be done next is on display line 4.
B. Parameter is in Edit Mode. In this mode, pressing Esc button restores the original setting and returns to View Mode.
C. The UP-ARROW button is used to scroll up through the numbers and decimal point, and the DOWN-ARROW button scrolls down through the numbers and decimal point.
D. Parameter has returned to View Mode.

How to edit the calendar date parameter

1. Navigate to the **Date** parameter screen (see Figure 4-9 on page 35).
2. When entering any parameter screen, it is in **View Mode** (Figure 4-10 on page 35). Help with what can be done next is on display line 4.

   *(In View Mode, the **Esc** button is used to leave (quit) the parameter screen. The **SETTINGS** menu then re-appears, as seen before selecting the parameter screen).*
3. To enter **Edit Mode**, press the **red (ENTER)** button.
4. The **"3"** is highlighted to show this digit can now be edited (Figure 4-10).

   *(Also, note that on display line 4, "**Edit**" has changed to be "**Save**").*
5. Change the calendar date from **"30/01/14"** to **"31/01/14"**:
   a. Press the **RIGHT-ARROW** button once to move right one space and highlight the **"0"**.

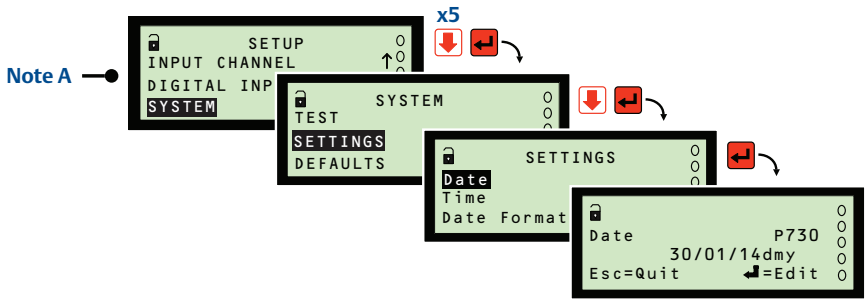
      *(The **LEFT-ARROW** can be used to move the highlight back one space).*

b. Press the **UP-ARROW** button once to change the **"0"** to a **"1"**.
*(The **DOWN-ARROW** can be used to cycle backwards through the digits and decimal point).*

6. Press the **red (ENTER)** button to save the new date and return to **View Mode**.
*(Note that on display line 4, "**Save**" has changed back to "**Edit**").*

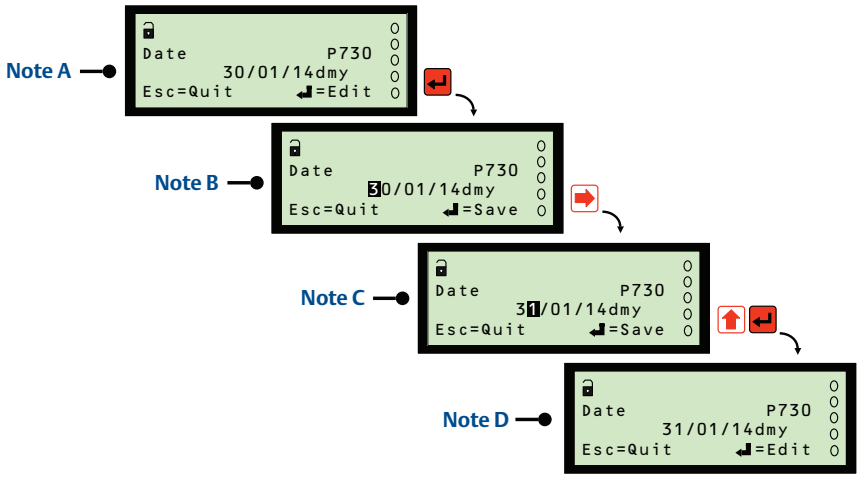
7. Press the **Esc** button to return to the **SETTINGS** menu.

Figure 4-9. Navigation to the calendar date screen



A. This is the SETUP menu for the control unit – see Figure 4-6 on page 31 for how to get here.

Figure 4-10. Example of editing the calendar date



A. When entering any parameter screen, it is in View Mode. Help with what can be done next is on display line 4.
B. Parameter is in Edit Mode. In this mode, pressing Esc button restores the original setting and returns to View Mode.
C. The UP-ARROW button is used to scroll up through the numbers and decimal point, and the DOWN-ARROW button scrolls down through the numbers and decimal point.
D. Parameter has returned to View Mode.

The basics about the menu navigation

In this chapter and throughout this manual, a simple notation has been used to guide you to a particular menu screen or parameter screen. This avoids the need for detailed navigation instructions.

Consider the navigation instructions to be followed before arriving at the **ADVANCED** menu. For the purpose of this example, the starting point is the Full PV Display.

In the notation form, this is simply:

1. Navigate to **MAIN MENU / ADVANCED**

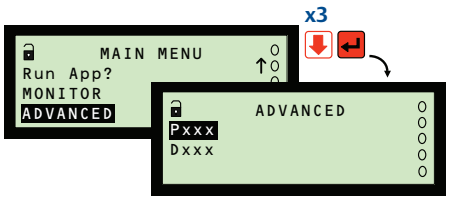
Without the notation, this translates into these instructions:

1. Press the **red (ENTER)** button to display the **MAIN MENU** screen.
2. Press the **DOWN-ARROW** button three times until **ADVANCED** is highlighted and blinking.
3. Press the **red (ENTER)** button once.

If square brackets are used in the notation, e.g. **MAIN MENU / SETUP / [CONTROL UNIT]**, it signifies that the bracketed menu does not appear in all circumstances.

When HART transmitters are not being used, the **SELECT INSTRUMENT** screen does not appear. As there is no need to select the control unit menu or a HART transmitter (Tx1 or Tx2) menu, the menus that appear after selecting **MAIN MENU / SETUP** are purely for the control unit.

Figure 4-11. Navigating to the ADVANCED menu



4.5.2 Step-by-step programming of the control unit

Step 1: Put the unit into Program mode

Put the control unit into **Program** mode. (The factory default is for it to be in **Program** mode). See "Run App and Program operating modes" on page 38.

Step 2: Use the App Wizard

Use the Application Wizard (App Wizard) to easily set-up the control unit for a level, flow, or contents volume application, and then optionally adjust the set-up by editing parameters in the menu system. For examples of using the App Wizard, see"Application Wizard" on page 39.

Note:

- Before using the App Wizard with a 4–20 mA transmitter, the Input Channel 1 source parameter **P111** on the control unit must be set for a 4–20 mA input (see page 44)
- Level and volume measurement duties are not available on the MCU90F Logging unit.

Step 3: Optional changes after using the App Wizard

Optionally change system settings

This includes how to switch on the keyboard sound, setting the date/time, and changing language. See "Optional change: system settings" on page 42.

Optionally change transmitter input channel settings (advanced users)

This is for advanced users and looks in-depth at how the input channels are used to obtain the control unit Process Value / Primary Value (PV) value from a transmitter.

See "Optional change: transmitter input channel settings (advanced users)" on page 43

For most users, the App Wizard will set-up the majority of applications with no need of direct changes to input channel parameters.

Optionally change application settings (advanced users)

This is for advanced users and looks in-depth at further processing of PV values to get content (volume) or flow rate values, which can be shown on the display. A totalizer function can also be set-up. **For most users, the App Wizard will set-up the majority of applications with no need of direct changes to application parameters.**

See "Volumetric contents and flow measurement applications (advanced users)" on page 52 and "Using a plotted profile for calculating volume or flow" on page 61.

Optionally change the digital input settings

This includes how to allocate actions to digital inputs (IN1 and IN2).
See "Digital inputs IN1 and IN2" on page 63.

Optionally change output settings

This includes setting-up the 4–20mA output and relay outputs.
See "Set-up the current output" on page 68 and "Set-up the relays" on page 69.

Optionally set-up other features

This includes configuring data logging (page 64), alarm handling (page 91), the display (page 102), serial communications (page 104), and PIN security (page 105).

By default, security restrictions are switched off and the user has access to all parameters. After programming (configuring) is complete, a PIN security code can be used to prevent unauthorized access. For details, refer to Section "PIN Security" on page 105.

Step 4: Put the unit into Run App mode

Put the control into **Run App** mode (see below).

For checks e.g. auto-cycle of the control unit Primary / Process Value (PV), diagnostics, and fault-finding, see Section 5: Servicing and Health Checking.

There is trouble-shooting information in Section 5: Servicing and Health Checking. Alternatively, the MCU900 Series control unit can be re-set to the factory defaults as guided in the Section "Restoring the factory defaults" on page 135.

4.5.3 Run App and Program operating modes

Menu: MAIN MENU / Run App? (or MAIN MENU / Program?)

There are two operating modes on the control unit: **Run App** and **Program**.

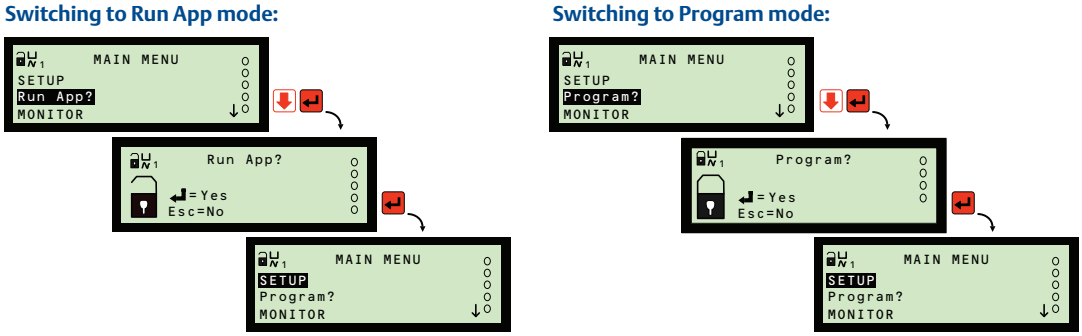
Press the **red (ENTER)** button at the **Run App?** or **Program?** screen to switch between these two operating modes (Figure 4-12)

An open padlock icon indicates the MCU900 Series control unit is presently in the **Program** mode.
In this mode, the unit can be programmed. The Current Output and all Relay Outputs are frozen unless allocated to totalizing and sampler duties. Fault relays are de-energized.

A closed padlock icon indicates that the MCU900 Series control unit is presently in the **Run App** mode. In this mode, most of the unit cannot be programmed. The Current Output and all Relay Outputs operate as normal.

The **Program?** screen (Figure 4-12) appears automatically if an attempt is made to edit a parameter whilst in **Run App** mode. A security PIN can be set-up to restrict the mode change.

Figure 4-12. How to switch between Run App and Program modes



4.5.4 Application Wizard

Use the Application Wizard (App Wizard) to easily set-up the control unit for an application.

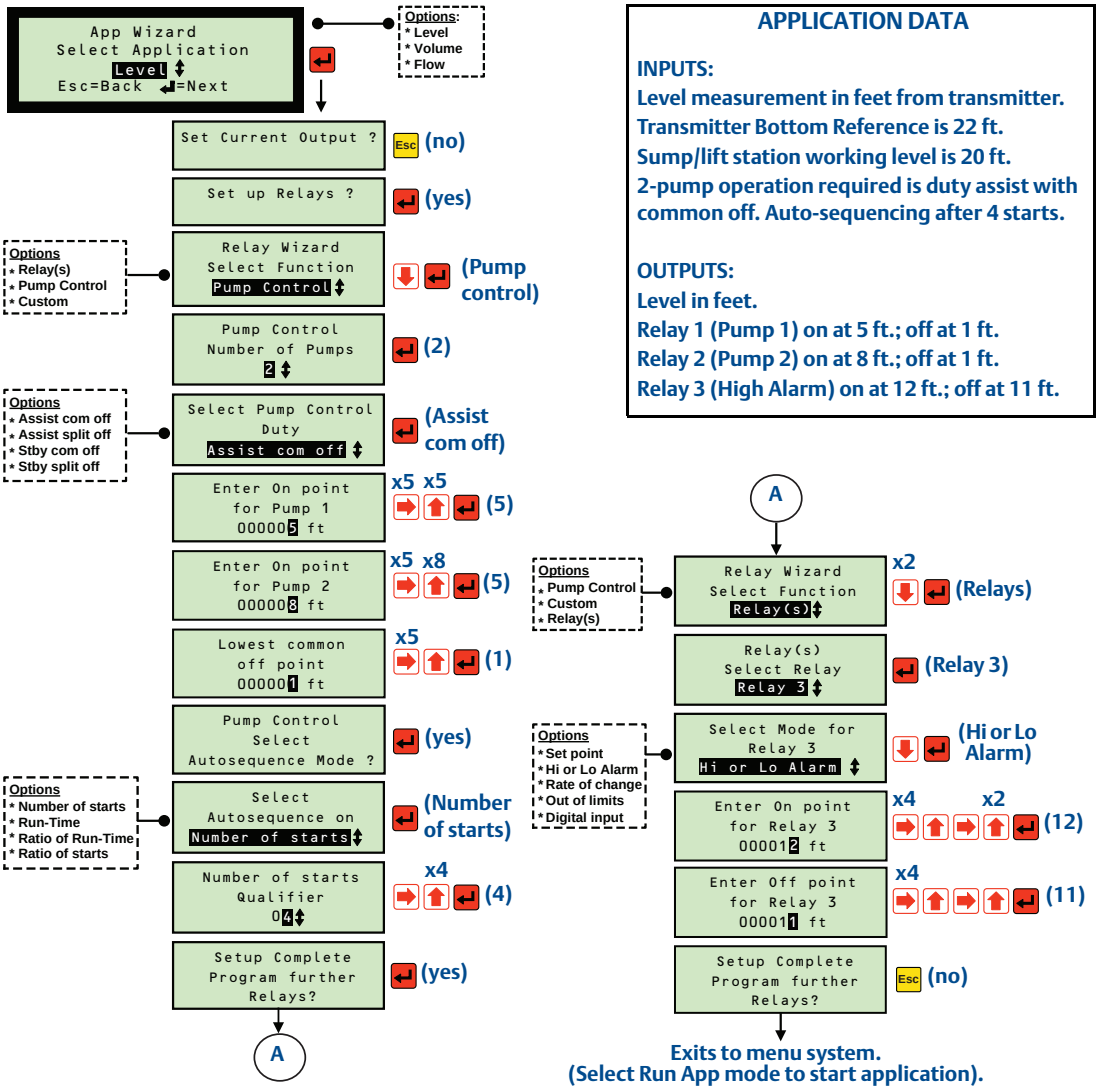
If a message appears saying that the units are not set, it is because the HART transmitter has not been found by the control unit when power was applied. Change the operating mode from **Program** to **Run App** mode and the control unit will attempt to re-connect to the transmitter.

Note

- When using a MCU902 control unit, it is necessary to select Difference, Sum, Product, or Independent (and channel) before Level/Volume/Flow can be selected.
- Level and volume measurement duties are not available on the MCU90F Logging unit.

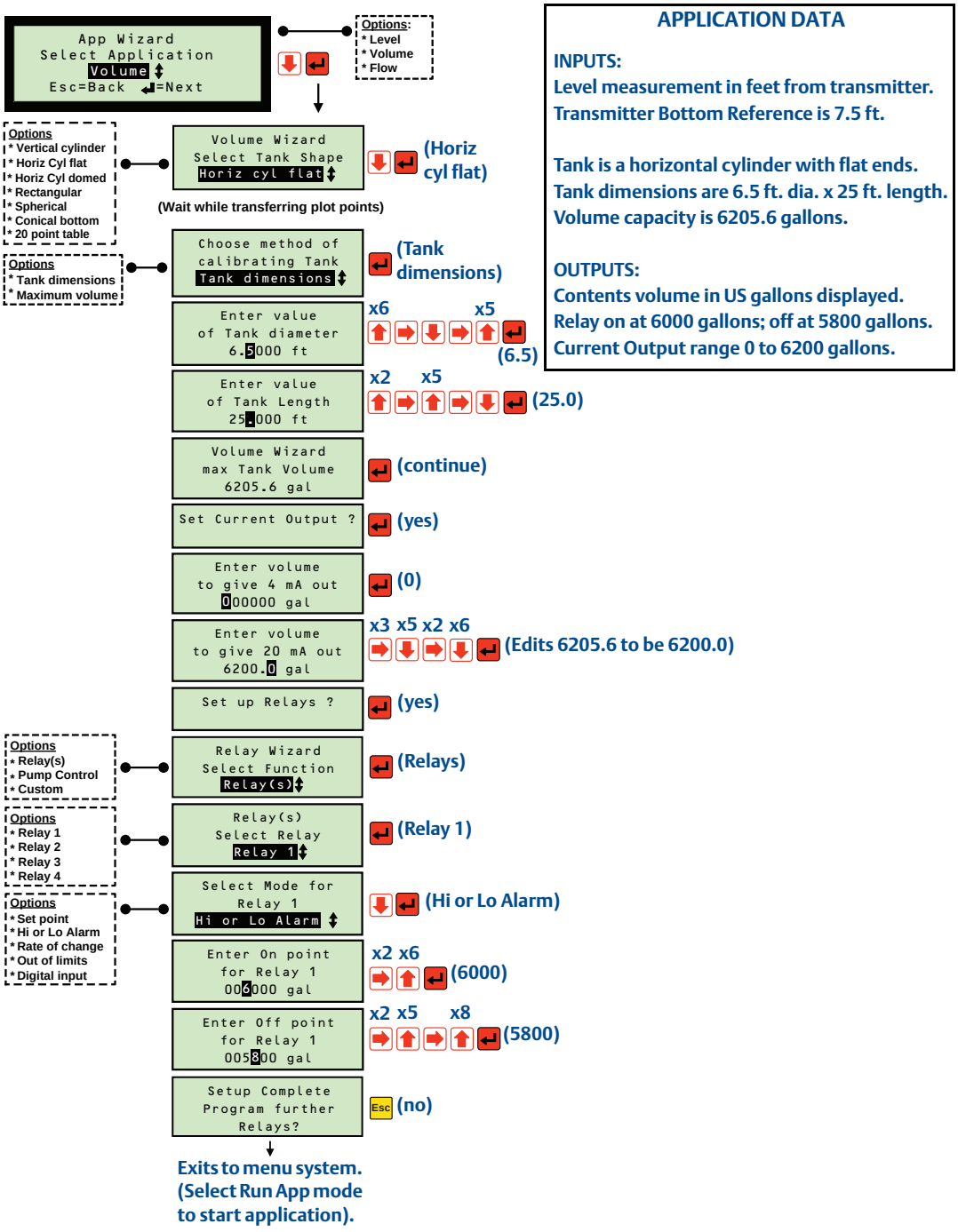
Using the App Wizard to set-up a level application

Figure 4-13. App Wizard example: pump control with a high alarm



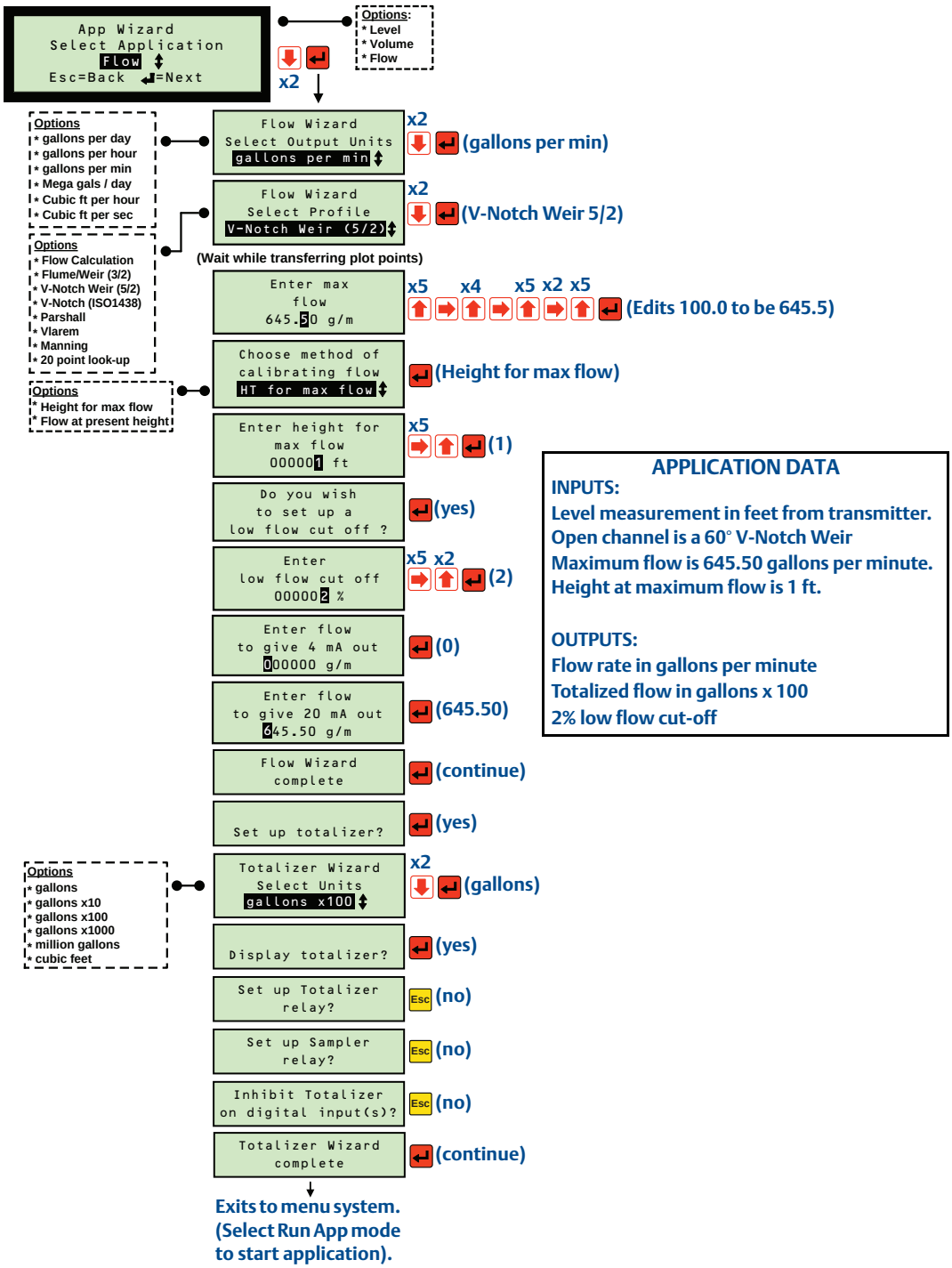
Using the App Wizard to set-up a contents volume application

Figure 4-14. App Wizard example: tank volume with a high alarm



Using the App Wizard to set-up a flow application

Figure 4-15. App Wizard example: open channel flow with a 60° V-Notch Weir



4.5.5 Optional change: system settings

Menu: SETUP / [CONTROLLER /] SYSTEM / SETTINGS

Calendar clock

P730 Date

Set the calendar date in the format as selected by P734.

P731 Time

Set the clock time. The 24-hour clock format is supported.

P734 Date format (Default setting is "dd/mm/yy")

Choose between “dd/mm/yy”, “yy/mm/dd”, and “mm/dd/yy”.

Keypad sound

P735 Keypad Sound (Default setting is **“**Off**”**)

If you want the keypad sound switched on, select “**On**” from the option list.

Language

P737 Language (Default setting is "English")

If you wish to change the language used on-screen, there is a choice of other languages.

4.5.6 Optional change: transmitter input channel settings (advanced users)

Sections 4.5.6 to 4.5.9 are for advanced users. They explain in-depth what transmitter inputs are supported on the control unit, and how to program (configure) the operation of those transmitter inputs to result in a **control unit Primary / Process Value (PV)**.

The resulting control unit PV is indicated on the factory-default configured display.

For most users, the App Wizard will set-up the majority of applications with no need of direct changes to input channel parameters.

Transmitter input channels on the Mobrey MCU901 and MCU90F

The MCU901 and MCU90F control units support the connection of a *single* 4–20 mA or HART transmitter. There is one transmitter input channel and it is referred to as **Input Channel 1**.

For a 4–20 mA transmitter:

- See "Programming Input Channel 1 for a 4–20 mA input (advanced users)" on page 44.

For a HART transmitter:

- See "Programming Channel 1 for a HART input (advanced users)" on page 48.

Transmitter input channels on the Mobrey MCU902

The MCU902 control unit supports the connection of two HART transmitters, but not two 4–20 mA transmitters. The input channels and are referred to as **Input Channel 1** and **Input Channel 2**.

For two HART transmitters:

- See "Programming Channel 1 for a HART input (advanced users)" on page 48.
- See "Programming Channel 2 for a HART input (MCU902 only) (advanced users)" on page 50.

Sum, difference, or product calculations using input channels 1 and 2

Parameter **P150** selects how final values from transmitter input channels 1 (**D851**) and 2 (**D852**) are processed together – sum, difference, or product calculation – before being output to parameters **D800**, **D801**, **D802**, or **D803** ('Answers').

The factory default programming (configuration) for **P150** is to allow values from **D851** to go straight to **D800**.

For a graphical overview, see Figure 4-17 and Figure 4-18 on page 47.

4.5.7 Programming Input Channel 1 for a 4–20 mA input (advanced users)

This section explains how to program (configure) the operation of the Input Channel 1 on the control unit when a 4–20 mA transmitter is connected. **Do not connect a second transmitter.** Please read this section together with the graphical overview in Figure 4-16 on page 47.

The final result of the **Input Channel 1** processing is stored in **D800** and is referred to as the **control unit Primary / Process Value (PV)**. It is shown on the factory default configuration of the display.

Essential parameters to program

Select the displayed units for the control unit Primary/ Process Value (PV)

First, it is essential to know the units for the measurements coming from the transmitter. When this is known, navigate the menu system to SETUP / [CONTROLLER /] DISPLAY / PV Units for the **PV Units** parameter **P200** and then select the measurement units that are to be shown for the control unit PV on the display.

Please note that the PV Units parameter (**P200**) does not automatically convert the transmitter input or the control unit PV into alternative units. It is necessary to enter a conversion factor into parameter **P114** (see the descriptions that follow).

Set Input Channel 1 to receive input from a 4–20 mA transmitter

1. Navigate to the menu SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 I/P Source for the **Ch1 I/P Source** parameter **P111**.
2. Select **mA in 1** from the option list.

Note

- The built-in Application (App) Wizard is an easy-to-use configuration tool that can be used to automatically populate values and settings in the input channel parameters.

  Navigate to: SETUP / [CONTROLLER /] APPLICATION / App Wizard

- Before using the App Wizard with a 4–20 mA transmitter, the Input Channel 1 source parameter **P111** on the control unit must be set for a 4–20 mA signal input; this is not the factory default setting for **P111.**

Optional parameters and how the 4–20 mA signal is processed

Figure 4-16 on page 47 shows how the 4–20 mA input signal is processed through Input Channel 1 and which parameters and processing stages affect the resulting control unit PV.

Signal conditioning and damping stages

Analog measurements (level, pressure, and temperature, etc.) are input to the control unit as a 4–20 mA signal, and pass through a conditioning stage (to remove spikes) and a damping stage (to smooth out large jumps in signals).

The damping can be adjusted by changing the time setting (in seconds) in parameter **P321**. Navigate to the menu SETUP / [CONTROLLER /] INPUT CHANNEL / Cur I/P Damping.

Signal limits check

The signal is then checked to ensure it is within the range of 3.7 to 20.75 mA. Signals outside this range cause an alarm condition, which may be externally signalled using a control unit relay (see "Alarm indication selection" on page 91).

Conversion of signal into a percentage value

By default, the mA signal (readable via **D840**) is converted (normalized) into a percentage in the range 0 to 100% (readable via **D842**), where 4 mA is 0% and 20 mA is 100%.

Note

- The control unit can process mA input values in the range 3.8 to 20.5 mA
- Read-only parameters **D840** and **D842** are in the menu MONITOR / DIAGNOSTICS

Applying the optional percentage offset adjustment

P112 is a positive, negative, or zero offset adjustment of the converted (normalized) percentage. This optional offset feature can be used to accommodate a standing level in a tank.

Note

- The output from this adjustment is readable in **D802** and is the **Tertiary Value (TV)** of the control unit. **D802** = **D842** + **P112**
- **P112** is in the menu SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 I/P Offset

Applying the scaling factor to get the required units

Changing the PV display units (**P200**) does not automatically convert the control unit PV to be in alternative units. A user-entered value in **P114** is used to convert (scale) the offset-adjusted percentage value (**D802**) to a new value (**D801**) that is in the required measurement units.

If the mA input represents a liquid level, simply set **P114** to the level represented by 20 mA.

Note

- **D801** is the **Secondary Value (SV)** of the control unit. D801 = (D802/100) * P114
- **P114** is not applied if the PV display units (**P200**) are already configured to be **"%"**
- **P114** is in the menu SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 Pre Scale
- Read-only parameters **D80*** are in the menu MONITOR / READINGS

Optional calculation of contents (volumetric) or flow measurement

By selecting a vessel profile or calculation using **P113**, a level measurement in **D801** can be used to calculate a volume measurement or open channel flow rate that is then stored in **D851**. The programming (configuring) required for this is in "Volumetric contents and flow measurement applications (advanced users)" on page 52.

Applying an optional low volume or flow rate cut-off action

The channel 1 output result in **D851** can be forced to zero when it falls below a positive threshold, which is a percentage of the maximum flow. Enter the percentage in **P117**. By default, the setting is "None" to switch off this optional check.

This feature is particularly useful in an open channel flow application where a small standing or remaining liquid level in the channel would cause continued totalizing of flow when no actual flow exists. As a guide, set **P117** to a positive value of 2% of maximum flow to overcome this problem.

Note

- **P117** is in the menu SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 Low Cut-off

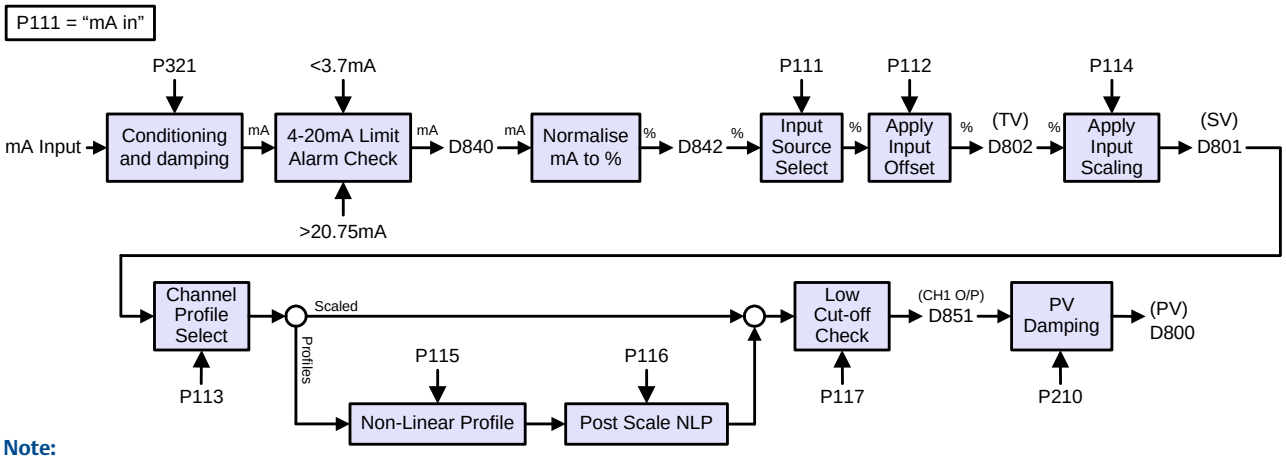
Applying optional damping to the control unit PV

P210 allows the to smooth out large steps in calculated values (**D851**).

Note

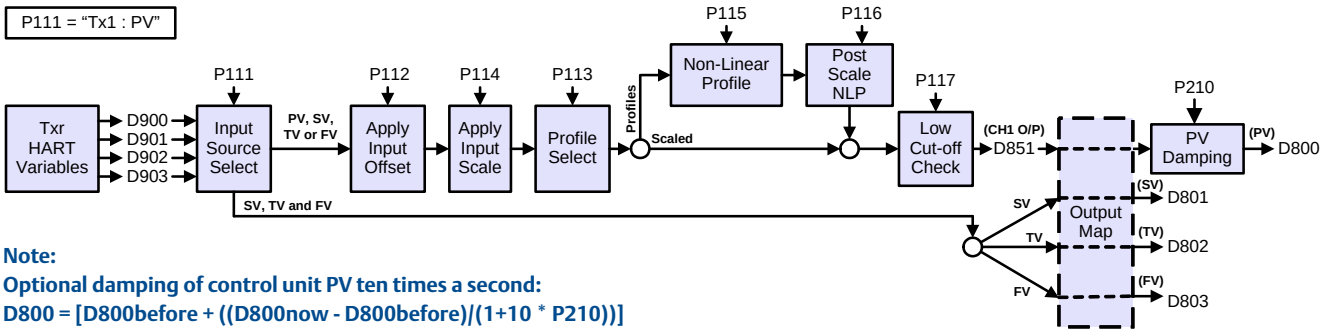
- **P210** is in the menu:
  SETUP / [CONTROLLER /] OUTPUT / PV DAMPING / MCU PV DAMPING
- **D851** is in the menu:
  MONITOR / DIAGNOSTICS / CHANNELS / Ch1 Output

Figure 4-16. Transmitter Input Channel 1 for a 4–20 mA input



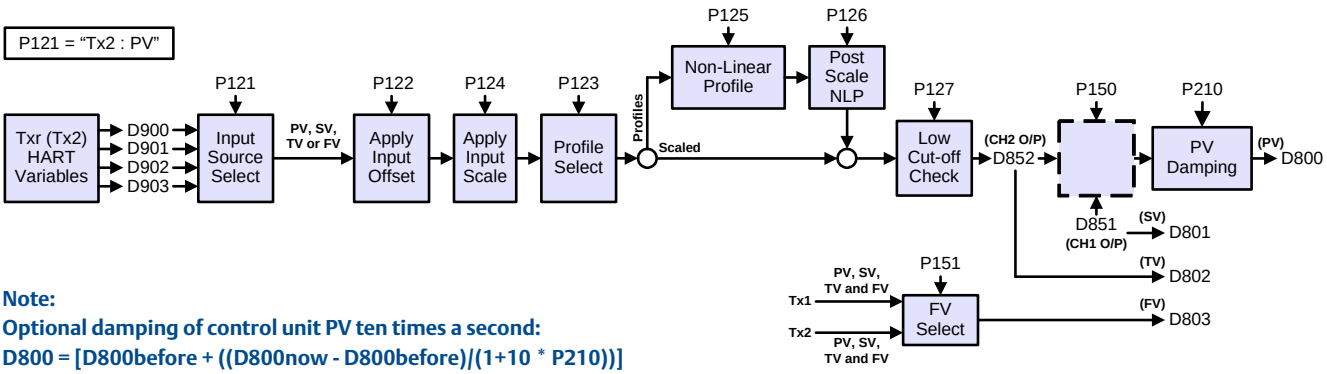
Note:
Optional damping of mA readings ten times a second: mA = [mA_before + ((mAnow - mA_before)/(1+10 * P321))]
Optional damping of control unit PV ten times a second: D800 = [D800before + ((D800now - D800before)/(1+10 * P210))]

Figure 4-17. Transmitter Input Channel 1 for a HART input



Note:
Optional damping of control unit PV ten times a second:
D800 = [D800before + ((D800now - D800before)/(1+10 * P210))]

Figure 4-18. Transmitter Input Channel 2 for a HART input



Note:
Optional damping of control unit PV ten times a second:
D800 = [D800before + ((D800now - D800before)/(1+10 * P210))]

4.5.8 Programming Channel 1 for a HART input (advanced users)

This section explains how to program (configure) the operation of the Input Channel 1 on the control unit when a HART transmitter is connected. Read this section together with the graphical overview in Figure 4-17 on page 47.

Note

- Parameters from the HART transmitter are available on the control unit from the SETUP and MONITOR menus, selectable from the main menu.

Essential parameter to program

Set Input Channel 1 to receive HART digital data from a transmitter

1. Navigate to the **Ch1 I/P Source** parameter **P111**:

   SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 I/P Source (on MCU901/3)
   SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 / Ch1 I/P Source (on MCU902)

2. Select **Tx1: PV** from the option list.

Note

- The built-in Application (App) Wizard is an easy-to-use configuration tool that can be used to automatically populate values and settings in the input channel parameters.

  Navigate to: SETUP / [CONTROLLER /] APPLICATION / App Wizard

- Before using the App Wizard, the Input Channel 1 parameter **P111** on the control unit must be set for a HART input. This is the factory default setting for **P111**.

Optional parameters and how the HART data is processed

Figure 4-17 on page 47 shows how the HART data is processed through Input Channel 1 and shows which parameters and processing stages affect the result from Input Channel 1.

HART digital data is continuously read from the transmitter

The HART transmitter digitally communicates pre-calculated values of four HART variables Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV), and Fourth Variable (FV) to the MCU900 Series control unit.

Selection of a HART variable as source for further processing

Parameter **P111** selects one of the four HART variables (PV, SV, TV, or FV) on the transmitter to be the source for further processing to get a result from Input Channel 1. The un-selected HART variables are mapped to control unit **D80x** parameters (see Figure 4-17 on page 47).

Note

- In Figure 4-17 on page 47, the selected source is the HART Primary Variable (PV). Alternatively, **Tx1: SV**, **Tx1: TV**, or **Tx1: FV** can be selected.
- Read-only parameters **D80*** are in the menu MONITOR / READINGS

Applying the optional offset adjustment to the selected source

Parameter **P112** is a positive, negative, or zero offset for adjustment of the selected HART variable. As an example, this feature may be used to handle a standing level in a tank.

Note

- **P112** is in the menu:
  SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 I/P Offset (on MCU901/3) or
  SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 / Ch1 I/P Offset (on MCU902)

Applying the optional scaling and profiling to the selected source

If volumetric or flow values are in the selected HART variable, set parameter **P113** to **Scaled**. Use parameter **P114** to convert (scale) the value into units that match the display units you may have selected (**P200**, **P201**, **P202** or **P203**, as applicable in SETUP / [CONTROLLER /] DISPLAY).

If level values are in the selected HART variable, parameter **P113** can be set to **Scaled** if wanting just level measurement, and then use parameter **P114** as described above. By selecting profile calculation using **P113**, a level value can be used to calculate a volumetric or open channel flow rate. The programming (configuring) required for this can be found in "Volumetric contents and flow measurement applications (advanced users)" on page 52.

Note

- **P113** and **P114** are in the sub-menus /Ch1 Profile and /Ch1 Pre scale at:
  SETUP / [CONTROLLER /] INPUT CHANNEL (on MCU901/3) or
  SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 (on MCU902)

Applying an optional low-cut-off action

The channel 1 output result in **D851** can be forced to zero when it falls below a positive threshold, which is a percentage of the maximum flow. Enter the percentage in **P117**. By default, the setting is "None" to switch off this optional check.

This feature is particularly useful in an open channel flow application where a small standing or remaining liquid level in the channel would cause continued totalizing of flow when no actual flow exists. As a guide, set **P117** to a positive value of 2% of maximum flow to overcome this problem.

Note

- **P117** is in this menu:
  SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 Low Cut-off (on MCU901/3) or
  SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 / Ch1 Low Cut-off (MCU902)

Applying optional damping to the control unit PV

P210 allows the user to apply damping to smooth out big steps in calculated values in **D851**.

Note

- **P210** is in the menu:
  SETUP / [CONTROLLER /] OUTPUT / PV DAMPING / MCU PV DAMPING
- **D851** is in the menu: MONITOR / DIAGNOSTICS / CHANNELS / Ch1 Output

4.5.9 Programming Channel 2 for a HART input (MCU902 only) (advanced users)

This section explains how to program (configure) the operation of the Input Channel 2 on the control unit when a HART transmitter is connected. Read this section together with the graphical overview in Figure 4-18 on page 47.

Note

- Parameters from the HART transmitter are available on the control unit from the SETUP and MONITOR menus, selectable from the main menu.

Essential parameter to program

Set Input Channel 2 to receive HART digital data from a transmitter

1. Navigate to:
   SETUP / [CONTROLLER /] INPUT CHANNEL / [CHANNEL 2 /] Ch2 I/P Source
   for the **Ch2 I/P Source** parameter **P121**.

2. Select **Tx2: PV** from the option list.

Note

- The built-in Application (App) Wizard is an easy-to-use configuration tool that can be used to automatically populate values and settings in the input channel parameters.

  Navigate to: SETUP / [CONTROLLER /] APPLICATION / App Wizard

- Before using the App Wizard, the Input Channel 2 parameter **P121** on the control unit must be set for a HART input. This is the factory default setting for **P121**.

Optional parameters and how the HART data is processed

Figure 4-18 on page 47 shows how the HART data is processed through Input Channel 2 and shows which parameters and processing stages affect the result from Input Channel 2.

HART digital data is continuously read from the transmitter

The HART transmitter digitally communicates pre-calculated values of four HART variables Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV), and Fourth Variable (FV) to the MCU900 Series control unit.

Selection of a HART variable as source for further processing

Parameter **P121** selects one of the four HART variables (PV, SV, TV, or FV) on the transmitter to be the source for further processing to get a result from Input Channel 2. The un-selected HART variables are mapped to control unit **D80x** parameters.

Note

- In Figure 4-18 on page 47, the selected source is the HART Primary Variable (PV). Alternatively, **Tx2: SV**, **Tx2: TV**, or **Tx2: FV** could have been selected.
- Read-only parameters **D80*** are in the menu MONITOR / READINGS

Applying the optional offset adjustment to the selected source

P122 is a positive, negative, or zero offset for adjustment of the selected HART variable. As an example, this feature may be used to accommodate a standing value of level in a tank. **P122** is in the menu SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2 / Ch2 I/P Offset.

Applying the optional scaling and profiling to the selected source

If volumetric or flow values are in the selected HART variable, set parameter **P123** to **Scaled**. Use parameter **P124** to convert (scale) the value into units that match the display units you may have selected (**P200**, **P201**, **P202**, or **P203**, as applicable in SETUP / [CONTROLLER /] DISPLAY).

If level values are in the selected HART variable, parameter **P123** can be set to **Scaled** if wanting just level measurement, and then use parameter **P124** as described in the paragraph above. By selecting profile calculation using **P123**, a level value can be used to calculate a volumetric or open channel flow rate. The programming (configuring) required for this can be found in "Volumetric contents and flow measurement applications (advanced users)" on page 52.

Note

- **P123** and **P124** are in the sub-menus /Ch2 Profile and /Ch2 Pre scale at: SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2

Applying an optional low-cut-off action

The channel 2 output result in **D852** can be forced to zero when it falls below a positive threshold, which is a percentage of the maximum flow. Enter the percentage in **P127**. By default, the setting is "None" to switch off this optional check.

This feature is particularly useful in an open channel flow application where a small standing or remaining liquid level in the channel would cause continued totalizing of flow when no actual flow exists. As a guide, set **P127** to a positive value of 2% of maximum flow to overcome this problem.

Note

- **P127** is in this menu: SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2 / Ch2 Low Cut-off

Applying optional damping to the control unit PV

P210 allows the user to apply damping to smooth out big steps in calculated values in **D852**.

Note

- **P210** is in the menu: SETUP / [CONTROLLER /] OUTPUT / PV DAMPING / MCU PV DAMPING
- **D852** is in the menu: MONITOR / DIAGNOSTICS / CHANNELS / Ch2 Output

4.5.10 Volumetric contents and flow measurement applications (advanced users)

Sections 4.5.11 to 4.5.17 are for advanced users. They explain in-depth how the can be set-up to use **level** measurements to calculate:

- the **volumetric contents** of a linear (uniform) shaped, covered vessel
- the **volumetric contents** or a non-linear (non-uniform) shaped, covered vessel
- **flow** in non-linear (non-uniform) shaped open channels, which can then be totalized
- **flow** in pre-programmed open channel flumes, which can then be totalized

The control unit has a built-in library of popular vessel profiles for volume of contents calculations and standard open channel profiles for flow calculations.

For other vessel and channel profiles, see "Set-up flow calculations for non-linear / non-uniform open channel profiles (advanced users)" on page 56.

4.5.11 Set-up the volumetric contents calculations for a popular linear / uniform vessel (advanced users)

The MCU900 Series control unit can use **level** measurements to calculate the **volumetric contents** of a linear (uniform) shaped, closed vessel e.g. a vertical cylinder or rectangular vessel.

Essential parameters to program

Set-up volumetric contents calculations for a linear (uniform) vessel

Parameter **P113** (or **P123**) must be set to **Scaled**, which establishes that the volume of the vessel contents is linearly derived from the liquid level measured by a transmitter (**D801**).

Parameter **P114** (or **P124**) must be set to:

- the maximum contents volume of the vessel (if 4–20 mA level transmitter is used) **or**
- the cross-sectional area of the vessel per unit of level measurement (if a HART level transmitter is used)

Note

- For a 4–20 mA transmitter measuring level, the volume is calculated as: **D851** = D801 where D801 = (D802 / 100) * P114
- For a HART level transmitter measuring level for Input Channel 1, the volume is calculated as: **D851** = (P114 * Level measurement after offset P112 is applied)
- For a HART level transmitter measuring level for Input Channel 2, the volume is calculated as: **D852** = (P124 * Level measurement after offset P122 is applied)
- **P113** and **P114** are in sub-menus /Ch1 Profile and /Ch1 Pre scale at: SETUP / [CONTROLLER /] INPUT CHANNEL (on MCU901/MCU90F) or SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 (on MCU902)
- **P123** and **P124** are in sub-menus /Ch2 Profile and /Ch2 Pre scale at: SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2 (on MCU902)
- Read-only parameters **D80*** are in the menu MONITOR / READINGS

4.5.12 Set-up the volumetric contents calculations for a popular non-linear / non-uniform shaped vessel (advanced users)

The MCU900 Series control unit can use **level** measurements to calculate the **volumetric contents** or a non-linear (non-uniform) shaped, closed vessel.

The control unit has a library of popular non-linear vessel shapes:

- Horizontal cylinder with flat ends
- Spherical vessel
- Horizontal cylinder with domed ends

Examples of popular applications are shown in Figure 4-19 on page 55.

Note

- For other vessel shapes, see "Set-up flow calculations for non-linear / non-uniform open channel profiles (advanced users)" on page 56.

Essential parameters to program

Select a popular non-linear vessel shape

Use parameter **P113** (or **P123**) to select a non-linear vessel shape from the option list.
The control unit then automatically populates **P115** (or **P125**) with data from the built-in library.

The volumetric contents calculations for these non-linear profiles require an input value over the range 0.0 to 1.0. Parameter **P114** (or **P124**) is therefore used to convert (scale) the input signal to a value within the range 0.0 to 1.0 for the volume calculation.

Note (MCU901/MCU90F)

- **P113**, **P114**, and **P115** are in the menus SETUP / [CONTROLLER /] INPUT CHANNEL /Ch1 Profile, /Ch1 Pre scale, and /Ch1 NLP Data respectively

Note (MCU902)

- **P113**, **P114**, and **P115** are in these menus:
  SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 / Ch1 Profile, /Ch1 Pre scale, and /Ch1 NLP Data (respectively)
- **P123**, **P124**, and **P125** are in these menus:
  SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2/ /Ch2 Profile, /Ch2 Pre scale, and /Ch2 NLP Data (respectively)

Setting P114 when a 4–20 mA level transmitter is connected

The 4–20 mA level transmitter should ideally provide a mA signal that is already scaled for the full vessel height. **P114** (or **P124**) can then be kept set at the default value of 1.0.

If the mA signal is not scaled for the full vessel height, **P114** (or **P124**) must be programmed with a value to convert (scale) the mA signal to be in the range 0.0 to 1.0. For example, if the maximum current is below 20 mA for a full vessel, say 18 mA, set **P114** = 16 * (18 - 4) = 1.143

Setting P114 (or P124) when a HART level transmitter is connected

The maximum level measurement from the HART transmitter must be equal to the height of the liquid when the vessel is full.

The level measurement, after any input offset has been applied, must be re-scaled to the range 0.0 to 1.0 ready for input to the NLP calculation.

For example, if the level measurement range is 0.0 to 4.0, set **P114** = (1.0 / 4.0) = 0.25

Setting P116 (or P126) to the maximum volume of the vessel

Parameter **P116** (or **P126**) must be programmed with the volume of the contents in a full vessel in the units chosen (**P200**, **P201**, **P202**, or **P203**, as applicable to the transmitter input channel).

The level measurement value, which is now in the range 0.0 to 1.0, is multiplied by the **P116** (or **P126**) value to get the volume of the contents. The resulting volume is then passed to the optional low volume cut-off action. See pages 45, 49, or 51, as applicable.

Note (MCU901/MCU90F)

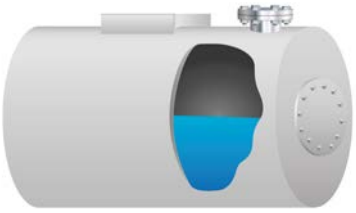
- **P116** is in the menu SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 Post Scale
- **P20x** parameters are in the menu SETUP / [CONTROLLER /] DISPLAY

Note (MCU902)

- **P116** is in this menu:
  SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1/ Ch1 Post Scale
- **P126** is in this menu:
  SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2/ Ch2 Post Scale
- **P20x** parameters are in the menu SETUP / [CONTROLLER /] DISPLAY

Figure 4-19. Examples of popular non-linear (non-uniform) vessel applications

P113/P123 = Horiz Cyl Flat
(Horizontal Cylinder, Flat Ends, Slope Ignored)



P114/P124 = (1.0 / Diameter of tank)
P115/P125 = Plotted non-linear profile of tank
P116/P126 = Full volume of ideal cylindrical tank

P113/P123 = Spherical

P114/P124 = (1.0 / Diameter of tank)
P115/P125 = Plotted non-linear profile of tank
P116/P126 = Full volume of ideal spherical tank

P113/P123 = Conical

P114/P124 = (1.0 / Maximum level)
P115/P125 = Plotted non-linear profile of tank
P116/P126 = Full volume of ideal conical tank

Note

- The non-linear profile (NLP) is plotted automatically when editing **P113** / **P123** manually or when using the Application (App) Wizard, *except* for the Conical NLP.
  Menu: SETUP / [CONTROLLER /] APPLICATION / App Wizard
- **P115** / **P125** is plotted with a simple cone if **P113** / **P123** is set to **Conical** manually.

4.5.13 Set-up flow calculations for non-linear / non-uniform open channel profiles (advanced users)

The MCU900 Series control unit can use **level** measurements to calculate **flow** in open channels, which can then be totalized. The control unit has a library of popular non-linear profiles for flow:

- Flume 3/2
- V-Notch 5/2
- Manning formula

Figure 4-20 on page 57 shows a typical open channel flow structure.

Essential parameters to program

Note

- **P200** (PV units) must be changed from **%** to the required units of measurement. The parameter **P200** is in the menu SETUP / [CONTROLLER /] DISPLAY

Select a standard non-linear open channel profile

Use **P113** (or **P123**) to select **V Notch (5/2)**, **Flume (3/2)** or **Manning** from the option list. The control unit then automatically populates **P115** (or **P125**) with data from the built-in library.

The flow calculations for these non-linear profiles require an input value over the range 0.0 to 1.0. Parameter **P114** (or **P124**) is therefore used to convert (scale) the input signal to be a value within the range 0.0 to 1.0 for the flow calculation.

Note (MCU901/MCU90F)

- **P113**, **P114**, and **P115** are in the menus SETUP / [CONTROLLER /] INPUT CHANNEL /Ch1 Profile, /Ch1 Pre scale, and /Ch1 NLP Data respectively

Note (MCU902)

- **P113**, **P114**, and **P115** are in these menus: SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 / Ch1 Profile, /Ch1 Pre scale, and /Ch1 NLP Data (respectively)
- **P123**, **P124**, and **P125** are in these menus: SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2/ /Ch2 Profile, /Ch2 Pre scale, and /Ch2 NLP Data (respectively)

Note

- When using the App Wizard, select **V-Notch Weir (5/2)**, **Flume/Weir (3/2)**, or **Manning** at the prompt for a profile. This populates parameter **P113** (or **P123**).

Setting P114 (or P124) when a 4–20 mA level transmitter is connected

The 4–20 mA level transmitter should ideally provide a mA signal that is already scaled for the full level range expected in the flow channel. **P114** (or **P124**) can then be kept set at the default value of 1.0.

If the mA signal is not scaled for the full level range of the channel, **P114** (or **P124**) must be programmed with a value to convert (scale) the mA signal to be a value in the range 0.0 to 1.0. For example, if the maximum current is below 20 mA for a full channel, say 12 mA, set **P114** = 16 * (12 - 4) = 2.

Setting P114 (or P124) when a HART level transmitter is connected

The maximum level measurement from the HART transmitter must be equal to the height of the liquid when the channel is full.

The level measurement, after any input offset has been applied, must be re-scaled to the range 0.0 to 1.0 ready for input to the NLP calculation.

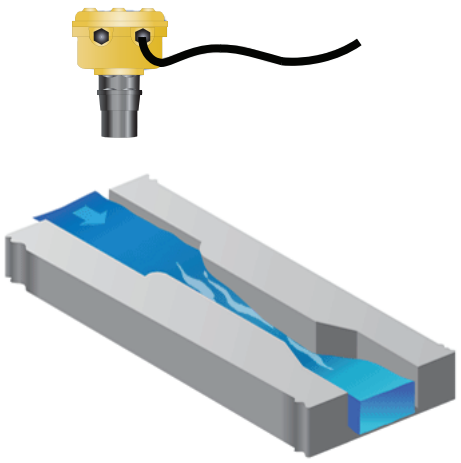
For example, if the level measurement range is 0.0 to 1.5 m, set **P114** = (1.0 / 1.5) = 0.667

Setting P116 (or P126) to the maximum flow expected in the channel

Finally, parameter **P116** (or **P126**) must be programmed with the maximum flow expected in the channel, which will occur at the maximum liquid level in the channel.

The control unit Primary/Process Value (**D800**) for the flow rate is derived by applying the normalized transmitter input (range 0.0 to 1.0) to the profile, and then converting (scaling) by parameters **P114** and **P116** (or **P124** and **P126**).

Figure 4-20. Example of a non-linear open channel profile



4.5.14 Set-up open channel flow calculations for pre-programmed flat, parabolic, and Parshall flumes (advanced users)

The MCU900 Series control unit has a library of data to set-up open channel flow calculations with flat, parabolic, and Parshall flumes.

Essential parameters to program

Note

- Flow calculations require the transmitter input channel(s) to be providing continuous level measurements (see page 43). Also, **P200** (control unit PV units) must be changed from the default **%** to the required flow measurement units.

Select a flume

Use parameter **P113** (or **P123**) to select a flume from the option list. The control unit then automatically populates parameter **P115** (or **P125**) with data from the built-in library.

The control unit uses **P115** (or **P125**) in a different way to when a plotted profile is required. For flat and parabolic flumes, it is used to store values for the flow calculation in cubic metres per hour (m^3/hour) where flow Q is given by:

$Q = k \times (h \times mul)^{Pwr}$

where **h** is the height of channel flow, and **k** and **Pwr** are factors.

When a **flat** or **parabolic** flume is selected, **P115** / **P125** (Pwr, k, and mul factors) and **P116** / **P126** are populated for measuring flow in metric units of cubic metres per hour (m^3/hour).

When a **Parshall** flume is selected, **P115** / **P125** (Pwr, k, and mul factors) and **P116** / **P126** are populated for measuring flow in imperial units of US gallons per minute (GPM).

For flow measurement in alternative units, with automatic scaling of the control unit PV, use the App Wizard (menu: SETUP / [CONTROLLER /] APPLICATION / App Wizard). The choice of units offered depends on whether the transmitter is measuring in metric or imperial units.

Note

- This modified version of the standard "$Q=k \times h^{Pwr}$" flow formula allows the use of a multiplier (mul) factor. This extra factor can account for irregularities or errors in the flow structure, but should only be manually entered where errors can be quantified.
- Pre-defined values for factors k, mul and Pwr of each standard flow structure in the library are shown in Table 4-1 on page 60 and Table 4-2 on page 60. Depending on the derivation of k and the level units, the h value is scaled by a different mul factor.
- Experienced users may wish to manually enter the values of k, mul or Pwr for specific applications. To edit these, set **P113**/**P123** to be "**`Flume***`**" and then edit k, mul or Pwr at parameter **P115**/**P125**. Use the **DOWN-ARROW** button to display the mul value.
- When a flume is selected from this list, the MCU900 Series control unit also populates parameters **P400** and **P401** (Current Output span), **P530** (Totalizer factor), and **P531** (Totalizer units of **`m³`** or **`galx100`**).

Note (MCU901/MCU90F)

- **P113**, **P115**, and **P116** are in the menus SETUP / [CONTROLLER /] INPUT CHANNEL /Ch1 Profile, /Ch1 NLP Data, and /Ch1 Post Scale respectively

Note (MCU902)

- **P113**, **P115**, and **P116** are in the menus SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 / Ch1 Profile, /Ch1 NLP Data, and /Ch1 Post Scale respectively
- **P123**, **P125**, and **P126** are in the menus SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2 /Ch2 Profile, /Ch2 NLP Data, and /Ch2 Post Scale respectively

Note

- When using the App Wizard, select **Parshall** or **Vlarem** at the prompt for a profile, and the next prompt then allows selection of the pre-defined calculation e.g. Flume Flat 1

4.5.15 Set-up Kindsvater Shen (V-notch ISO1438) flow calculations

P113/P123 = "**`Kindsvater Shen`**"

This flow calculation requires just the angle of the V-notch to be entered in parameter **P115** (or **P125**) to calculate a flow value over the weir. The head level measurement needs to be in units of metres and the resultant flow value is in cubic metres per second (m^3/s).

Note

- Flow calculations require the transmitter input channel(s) to be providing continuous level measurements (see page 43). Also, **P200** (control unit PV units) must be changed from the default **%** to the required flow measurement units.
- When using the App Wizard, select **V-Notch (ISO1438)** at the prompt for a profile. The App Wizard allows the selection of alternative flow units for the output result.

4.5.16 Set-up exponential flow law calculations

P113/P123 = "**`Flow calculation`**"

Exponential laws are supported by selecting this profile option, and manually entering values of k-factor, power, and mul into parameters **P115** (or **P125**).

The output is derived from the input value using: $\mathbf{Q = k \times (mul \times Input)^{pwr}}$

As an example, consider a an application with a rectangular weir and level measurements in ft. When the flow rate (**Q**) is 2000 GPM, the gauged head (**Input**) is known to be 0.792 feet. Terms **mul** is 1.000 and **pwr** is 1.5 for a rectangular weir.

Therefore, **k** is calculated as $\mathbf{Q}$ / $(\mathbf{mul \times Input})^{\mathbf{pwr}}$ = 2000 / $(1 * 0.792)^{1.5}$ = **2837.5**

Note

- Flow calculations require the transmitter input channel(s) to be providing continuous level measurements (see page 43). Also, **P200** (control unit PV units) must be changed.

Table 4-1. Pre-programmed flow calculation factors (Vlarem – flat and parabolic flumes)

Profile (P113/P123)	k (P115 or P125)	Pwr (P115 or P125)	Mul (P115 or P125)	P116 (or P126)
Flume Flat 1	0.1347877	1.5	0.01	3600.0
Flume Flat 2	0.1782664	1.5	0.01	3600.0
Flume Flat 3	0.3134177	1.5	0.01	3600.0
Flume Flat 4	0.5417157	1.5	0.01	3600.0
Flume Flat 5	0.8111058	1.5	0.01	3600.0
Flume Flat I	0.1322	1.5	0.01	3600.0
Flume Flat II	0.1777	1.5	0.01	3600.0
Flume Flat III	0.21758	1.5	0.01	3600.0
Flume Flat III bis	0.32835	1.5	0.01	3600.0
Flume Flat III ter	0.272	1.5	0.01	3600.0
Flume Flat IV	0.3521726	1.5	0.01	3600.0
Flume Flat V	0.442932	1.5	0.01	3600.0
Flume Flat V bis	0.4005	1.5	0.01	3600.0
Flume Flat VI	0.4990569	1.5	0.01	3600.0
Flume Flat VII	0.6237	1.5	0.01	3600.0
Flume Flat VIII	0.88116	1.5	0.01	3600.0
Flume Flt VIII bis	0.798	1.5	0.01	3600.0
Flume Flat IX	1.065186	1.5	0.01	3600.0
Flume Flat IX bis	0.8148	1.5	0.01	3600.0
Flume Flat X	1.3222761	1.5	0.01	3600.0
Flume Flat X bis	1.609	1.5	0.01	3600.0
Flume Flat X ter	1.064884	1.5	0.01	3600.0
Flume Flat XI	1.65099	1.5	0.01	3600.0
Flume Para 1	0.39885	2.3	0.01	3600.0
Flume Para 2	0.44187	2.3	0.01	3600.0
Flume Para 3	0.46362	2.2	0.01	3600.0
Flume Para 4	0.54419	2.2	0.01	3600.0
Flume Para 5	0.61851	2.1	0.01	3600.0
Flume Para 6	0.71726	2.1	0.01	3600.0
Flume Para 7	0.77152	2.1	0.01	3600.0
Flume***	(User)	(User)	(User)	3600.0

Note

- Vlarem flumes most commonly are used for open channel flow applications in Belgium. When selecting a Vlarem flume from the above list, the PV flow units are automatically set to m3/hr and the display configured to show the SV (level in cm on top line) and totaliser in m3 (on bottom line). The transmitter base units must be set to metres

Table 4-2. Pre-programmed flow calculation factors (Parshall flumes)

Profile (P113/P123)	Pwr (P115 or P125)	k (P115 or P125)	mul (P115 or P125)	P116 (or P126)
Parshall 1 in	1.550	151.7	1.0	1.0
Parshall 2 in	1.550	303.4	1.0	1.0
Parshall 3 in	1.547	445.2	1.0	1.0
Parshall 6 in	1.580	924.5	1.0	1.0
Parshall 9 in	1.530	1378	1.0	1.0
Parshall 1 ft	1.522	1795	1.0	1.0
Parshall 1.5 ft	1.538	2693	1.0	1.0
Parshall 2 ft	1.550	3590	1.0	1.0
Parshall 3 ft	1.566	5386	1.0	1.0
Parshall 4 ft	1.578	7181	1.0	1.0
Parshall 5 ft	1.587	8976	1.0	1.0
Parshall 6 ft	1.595	10770	1.0	1.0
Parshall 8 ft	1.607	14360	1.0	1.0
Parshall 10 ft	1.600	17672	1.0	1.0
Parshall 12 ft	1.600	20982	1.0	1.0

4.5.17 Using a plotted profile for calculating volume or flow

When parameter **P113** (or **P123**) is set to "**special**", the parameter **P115** (or **P125**) is used for defining a 20-point look-up table that represents the profile of a vessel or open flow channel that is not in the control unit library.

Note

- When using the App Wizard, select **20 point look-up** at the prompt for a profile.

Each point is a Cartesian co-ordinate (X, Y). The X value represents a level, and the Y value is the corresponding volume or flow rate. The X points are at user-defined intervals, typically in equal increments (5%) of maximum height.

These X points may be entered as levels (*in the same units as the transmitter*) and the Y points entered as the corresponding volumes or flow rates for those levels (*in the same units as selected for the control unit Primary/Process Value*). See Figure 4-21 on page 61, right-hand graph.

Parameters **P114** (or **P124**) and **P116** (or **P126**) need only be set to 1.0 for this method. The volume or flow rate for the control unit PV is then derived from the plotted profile using the live level measurements and interpolation between the plot points.

The X and Y points can also be converted (normalized) to be in the range 0.0 to 1.0 before being entered manually (see Figure 4-21 on page 61, left-hand graph). A value is then derived from the plotted profile using the live level measurements that are already converted (normalized) by the Transmitter Input Channel processing. Parameter **P116** (or **P126**) is then applied to the derived value to obtain the volume or flow rate for the control unit PV.

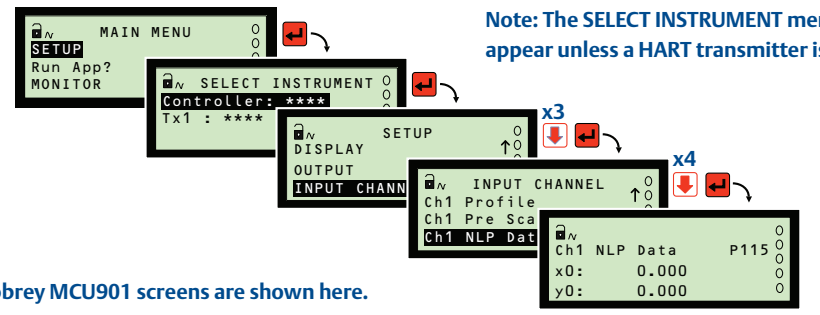
Note (MCU901/MCU90F)

- **P113** to **P116** are in the menus SETUP / [CONTROLLER /] INPUT CHANNEL / Ch1 Profile, / Ch1 Pre scale, / Ch1 NLP Data, and / Ch1 Post Scale

Note (MCU902)

- **P113** to **P116** are in the menus SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 1 / Ch1 Profile, / Ch1 Pre scale, / Ch1 NLP Data, and / Ch1 Post Scale
- **P123** to **P126** are in the menus SETUP / [CONTROLLER /] PV CALCULATION / CHANNEL 2 / Ch2 Profile, / Ch1 Pre scale, / Ch2 NLP Data, and / Ch2 Post Scale

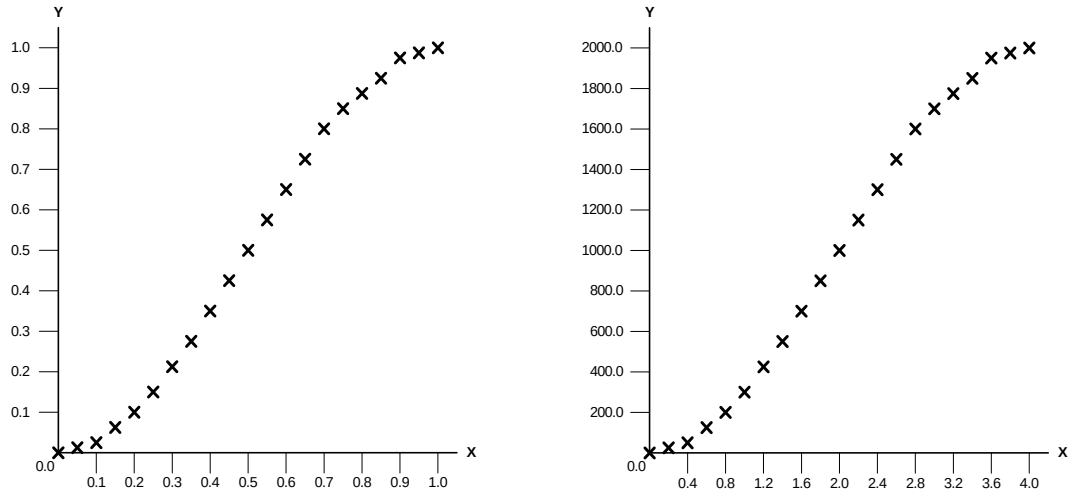
Figure 4-21. How to navigate to the P115 parameter screen



Note: The SELECT INSTRUMENT menu does not appear unless a HART transmitter is connected.

Note: The Mobrey MCU901 screens are shown here.

Figure 4-22. Examples of plotted profile for a spherical vessel



Normalized units (range 0.0 to 1.0)

Actual level (X) and volume (Y) units

How to edit the 'look-up' table (P115/P125)

1. Parameter **P113/P123** must first be set to be "**Special**".
2. Navigate to the **P115/P125** parameter screen (see Figure 4-21 on page 61).
3. Press the **red (ENTER)** button once to select point 0.

   Before editing, you can use the **DOWN-ARROW** button to page down to another point or use the **Esc** button to return to the menu.
4. With **X0:** highlighted, use the **RIGHT-ARROW** button to move across to the X0 value.
5. Use the **UP-ARROW** or **DOWN-ARROW** buttons to edit the X0 value.
6. Press the **red (ENTER)** button once to confirm the new X0 value.
7. With **Y0:** highlighted, use the **RIGHT-ARROW** button to move across to the Y0 value.
8. Use the **UP-ARROW** or **DOWN-ARROW** buttons to edit the Y0 value.
9. Press the **red (ENTER)** button once to confirm the new Y0 value.
10. To edit X0 and Y0 again, return to step 2. Otherwise, use the **DOWN-ARROW** button to display the page with X1 and Y1 or use the **Esc** button to return to the menu.
11. Repeat for all points in the profile.

    An X point with 0.0 terminates the profile (unless it is point X0, Y0).

Note

- The **Esc** button can be used during editing to abort and restore the original values; it needs to be pressed again to move back to the 'X' or 'Y' text

4.5.18 Digital inputs IN1 and IN2

Digital inputs IN1 and IN2 can be programmed to perform an action whenever they are triggered.

Note

- See for "Digital control voltage-free contact inputs" on page 21 terminal connections.
- Digital input IN1 and IN2 statuses are shown on the left-hand side of the display: o = inactive or ▸ = active.
- Parameter **D835** shows the statuses of the inputs: active (1) or inactive (0). First digit represents IN1. The second digit represents IN2.

How to allocate an action to IN1 or IN2:

1. Navigate to:
   SETUP / [CONTROLLER /] DIGITAL INPUT / DIGITAL INPUT 1 or / DIGITAL INPUT 2

2. Use the Action selection parameter **P340** (for IN1) or **P345** (for IN2) to select a trigger action from the option list. Table 4-3 lists all the options and explains their purpose.

3. Use the Delay parameter **P341** (for IN1) or **P346** (for IN2) if a delay is needed before an action is performed. The setting format is m:s (minutes and seconds).

4. Use the On State parameter **P342** (IN1) or **P347** (IN2) to change the logic of the input for triggering an action. Options are:
   "Closed" (default) – an action is triggered when the voltage-free contact is closed, or
   "Open" – an action is triggered when the voltage-free contact is open.

Table 4-3. Digital input actions

Action	Action that occurs while digital input is triggered
Free	Digital Input has no allocated action. This is the factory default setting.
Alarm (1)	Forces an alarm condition, which is indicated if specified in the OUTPUT / ALARM menu.
Fault (2)	Forces an fault condition, which is indicated if specified in the OUTPUT / FAULT menu.
Program mode	Changes the control unit operating mode to **Program** (open padlock).
Hold totalizer	Freezes the internal totalizer.
Hold MCU PV	Prevents the control unit PV value (**D800**) from being updated.
Suppress Alarm	If the digital input is active when an alarm condition is present, a message is displayed indicating the alarm is being overridden. The Alarm relay is held on.
Display Msg (3)	Displays a user-defined message (**P241**).
Log Input (4)	When the next data logging interval elapses, flag the data logged as a 'bad sample' if the digital input has been active.
Pump-down (5)	Invoke a pump-down operation.
Lock Params	Prevent 'P' prefixed parameters from being edited.
Protect totalizer 1	Prevent totalizer 1 from being reset.
Reset totalizer 2 (6)	Reset totalizer 2.

(1) See "Set-up alarms" on page 91 for information about alarms and features they affect.
(2) See "Fault mode relay" on page 82 for how to indicate fault conditions using a relay output.
(3) SETUP / [CONTROLLER /] APPLICATION/ Message.
(4) Data logging is available on the Mobrey MCU90F.
(5) The pump-down feature available on the Mobrey MCU901 and Mobrey MCU902. See "Pump-down (Mobrey MCU901 and MCU902 only)" on page 85 for further information.
(6) Totalizer 2 is available on the Mobrey MCU902 and Mobrey MCU90F.

4.5.19 Data logging on the Mobrey MCU90F

The Mobrey MCU90F can record (log) up to **7000 events** at regular intervals.

- Each event is a parameter value. The parameter to be recorded (logged) is the one selected for the middle section of the display (see Figure 2-4 on page 7).

  This *parameter-to-be-logged* is typically the control unit Primary/Process Variable (PV).

- If the MCU90F has been set-up to totalize, the daily value of the totalizer at midnight is also logged. Up to **60 midnight totalized values** are held in memory. This is in addition to the memory for 7000 events.
- The **maximum value** of the *parameter-to-be-logged* in each 24-hour period is also logged.

The MCU90F gives a visual indication that logging of data is underway by flashing "LOG" in the bottom, right-hand corner of the **Full PV Display**.

Note

- Logged data may be downloaded at any time using the RS232 data download socket, supplied with a Mobrey MCU90F (see "RS232 connections" on page 22), and Mobrey LOG-VIEW software running on a Windows PC.
- See "Serial communications" on page 104 for RS232 communication parameters.

Menu: SETUP / [CONTROLLER /] LOGGING

P590 Log Interval (Default is 15 minutes)

- The logging interval is the period over which the *parameter-to-be-logged* is sampled every five seconds and then averaged at the end. The averaged value is then logged.

  An interval value of 15 minutes logs the averaged value at 15-minute intervals, which equates to 50 days elapsed time.

P591 Fast Log (Fast log mode) (Default is 0)

- If the *parameter-to-be-logged* value is higher than a user-entered value (**P591**), the MCU90F automatically moves to a fast log mode.

  The *parameter-to-be-logged* is then logged once every minute until the logged value is less than **P591**. Fast logged values are tagged for easy identification when examining logged data.

P593 Low Mem Alarm (Default is 0%)

- An alarm can be raised to indicate when the unused memory falls to below a user-defined percentage (**P593**). See "Set-up alarms" on page 91 for selecting if this alarm is indicated by a relay output, driving the output current to a set level, or both.

  When the memory is full, logged data is either overwritten or the data logging stops, as determined by parameter **P592**.

- Parameter **D846** shows the percentage of free memory remaining for data logging.

P592 Data Overwrite (Default is "On")

- After the logging memory is full, there is a choice to continue data logging and overwrite the oldest data (**On**) or to stop data logging (**Off**).

Starting, stopping and resetting the logger

To start data logging, change the logging interval (**P590**) from 0 to the interval required. Logging is now activated.

Changing the logging interval from 0 to a logging interval in minutes will clear all data logged (i.e. clear the 7000 event-memory plus the 60 midnight totals).

Changing the log interval from a non-zero interval (e.g. 15 minutes) to a new non-zero interval (e.g. 5 minutes) will clear the 7000 event-memory).

To stop data logging, change the logging interval (**P590**) back to 0. Note, when the data logging interval is re-set, all logged data will be cleared from the logging memory.

Figure 4-23. Navigating to the LOGGING Menu

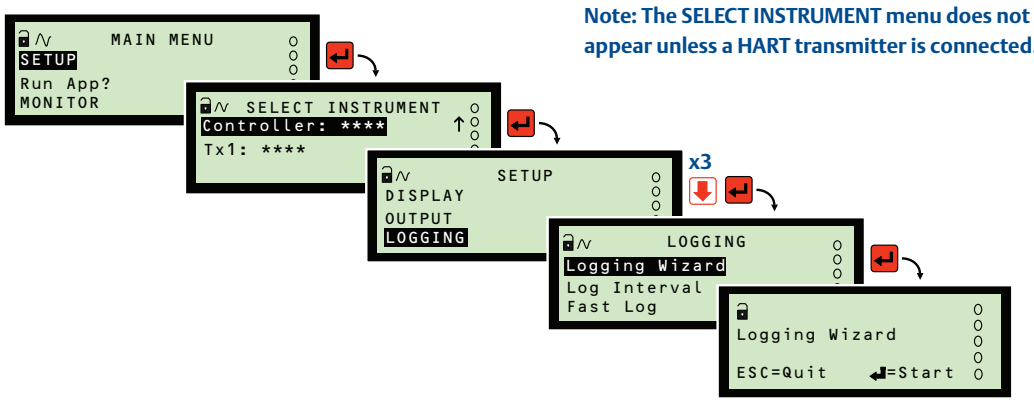
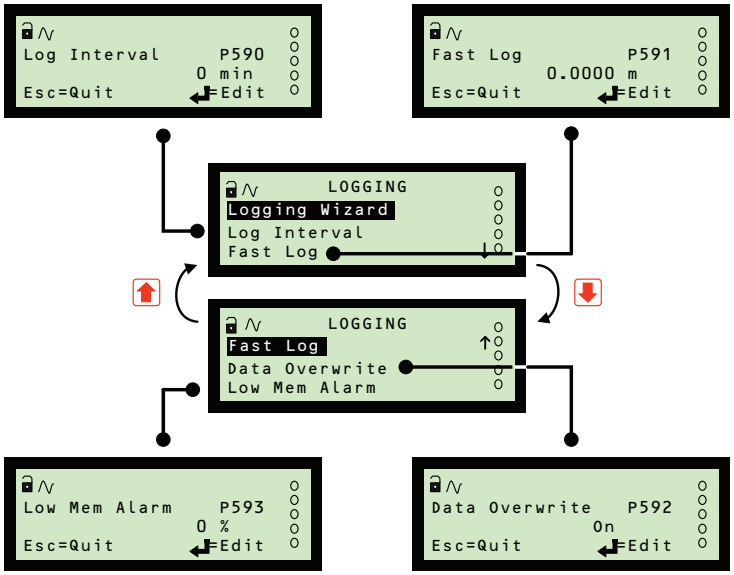


Figure 4-24. Menu map for LOGGING screens



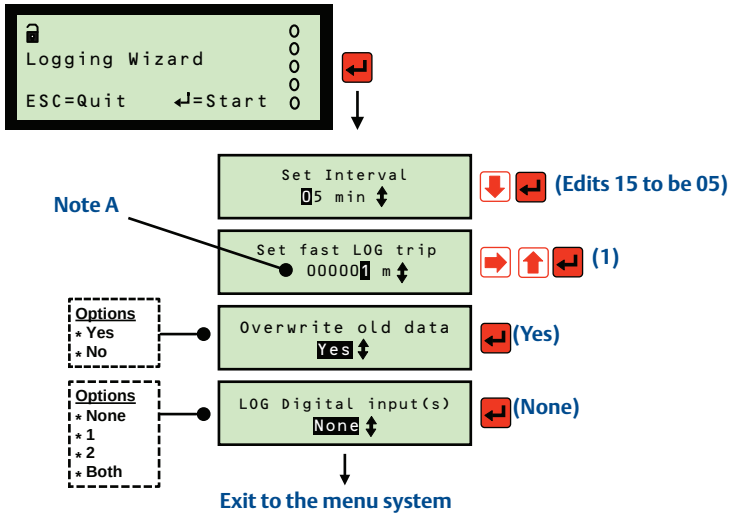
Using the Logging Wizard to set-up data logging of level measurements

The Logging Wizard is the easiest way to set-up the data logging feature after the main application is set-up.

As an example, consider data logging of the control unit PV value (**D800**) every 5 minutes; the control unit PV is a level measurement in metres. When that level measurement is at one metre or more, the Fast Log mode is required to activate. When the memory is full, old data is overwritten.

1. Navigate to the Logging Wizard screen in the menu system (Figure 4-23 on page 65).
2. Start the Logging Wizard by pressing the **red (ENTER)** button *once*.
   Change the operating mode to **Program** (Figure 4-12 on page 38), if prompted.
3. Work through the wizard prompts (Figure 4-25) until the menu system re-appears.
   Key presses for the wizard example are provided alongside the prompts.
4. Change the operating mode to **Run App** (Figure 4-12 on page 38).
5. Press the **Esc** button repeatedly until the **Full PV Display** appears. In the bottom-right of the display is now the word **LOG**, flashing to indicate that data logging is operating.

Figure 4-25. Logging wizard example with data logging of level measurements



A. Measurement units for this wizard are dependent on control unit PV display units selected using parameter **P200**.

Using the Logging Wizard to set-up of flow measurements

The Logging Wizard is the easiest way to set-up the data logging feature after the main application is set-up.

As an example, consider data logging of the control unit PV value (**D800**) every 15 minutes; the control unit PV is a flow measurement in cubic metres per second. When the flow measurement is at 1 cubic metre per second or more, the Fast Log mode is required to activate. When the memory is at 90% of capacity, a relay is activated instead of overwriting old data.

1. Navigate to the Logging Wizard screen in the menu system (Figure 4-23 on page 65).

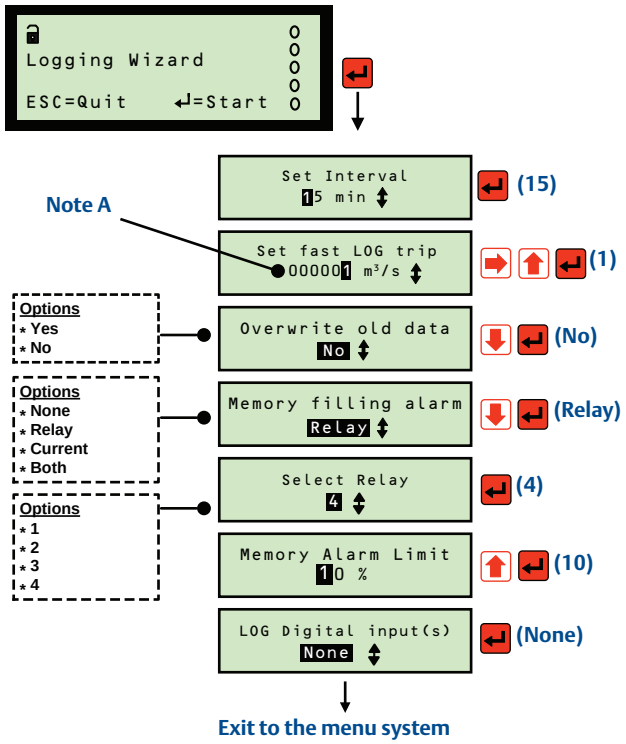
2. Start the Logging Wizard by pressing the **red (ENTER)** button *once*.
   Change the operating mode to **Program** (Figure 4-12 on page 38), if prompted.

3. Work through the wizard prompts (Figure 4-26) until the menu system re-appears.
   Key presses for the wizard example are provided alongside the prompts.

4. Change the operating mode to **Run App** (Figure 4-12 on page 38).

5. Press the **Esc** button repeatedly until the **Full PV Display** appears. In the bottom-right of the display is now the word **LOG**, flashing to indicate that data logging is operating.

Figure 4-26. Logging wizard example with data logging of flow measurements



A. Measurement units for this wizard are dependent on control unit PV display units selected using parameter **P200**.

4.5.20 Set-up the current output

The Current Output is for transmitting the control unit PV value (D800) as a 4–20 mA signal. The output is calculated by using the range values of parameters **P400** and **P401**.

Example
Consider a control unit PV value of 5 metres and the PV range is 0 to 10 metres:

- 0 metres is represented by a 4 mA signal (0%)
- 5 metres is represented by a 12 mA signal (50%)
- 10 metres is represented by 20 mA signal (100%)

Therefore, the Current Output would output the PV value 5 metres as a 12 mA signal.

Note
The current output is frozen while the control unit is in the **Program** operating mode.

Menu: SETUP / [CONTROLLER /] OUTPUT / CURRENT OUTPUT

P400 Low Range Val (Factory default is 0.0)

- This is the minimum control unit PV value represented by 4 mA.

P401 Up Range Val (Factory default is 100.0)

- This is the maximum control unit PV value represented by 20 mA.

P402 Alarm Actions (Factory default is 3.6 mA)

- Optional for determining how an alarm, if selected in the ALARM menu, is indicated on the Current Output. Options for **P402** are:

  3.6 mA – fix current output to 3.6 mA to force a low current limit alarm.

  Hold – freeze the current output at the present value.

  21 mA – fix current output to 21 mA to force high current limit alarm.

  See also Table 4-8 on page 94 for a summary of reporting methods for Alarms.

Note

- The **3.6 mA** and **21 mA** options are the Mobrey Standard.
- There is another alarm condition when the current output has reached the linear limit i.e. saturated. For the Mobrey Standard, this is ≤ 3.8 mA or ≥ 20.5 mA.

P404 mA Mode (Factory default is “Instantaneous”)

- On the Mobrey MCU90F, this optional parameter is for assigning the Current Output to follow a rolling average of the calculated control unit PV (typically flow). To do this, select the **Rolling** option.

  The time period for the rolling averaging is defined using **P590**, which is also for defining the logging interval (see “Data logging on the Mobrey MCU90F” on page 64).

P210 MCU PV Damping (Factory default is 0)

- This is used to apply damping to smooth out big steps in calculated control unit Primary/Process values (PV).

4.5.21 Set-up the relays

An overview of the relay functions

Relays 1 to 4 are normally **On Point / Off Point** control relays which may be used to start/stop pumps or open/close valves at different level points. The relay energizes at one level point and then de-energizes at a different level point.

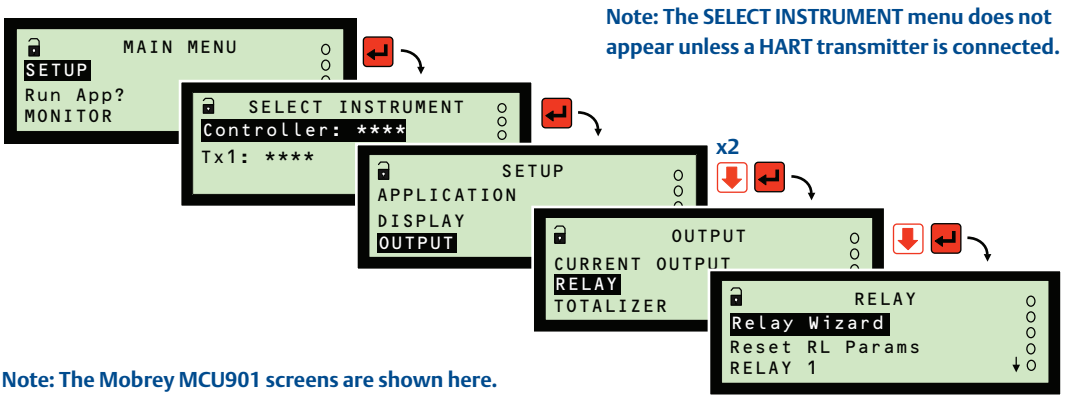
Relays can also be programmed as **Out-of-limit Alarm** relays which energize between defined points and de-energize outside those points. The relays may also be programmed to perform auto-sequences and auxiliary functions such as pump-down operations, pump rotations to equalize wear, and de-sludge/cleaning. For further details, see "Other relay modes" on page 71.

Relay 5 is normally a **Fail-safe Fault** relay but may be re-allocated to another duty.

How to start and use the Relay Wizard

Relays can be programmed easily using the Relay Wizard, accessible by navigating to the RELAY menu. The Relay Wizard also forms a part of the Application (App) Wizard.

Figure 4-27. Navigating to the RELAY Screen



Understanding the relay status icons on the display

The relay status icons on the Full PV Display have the following meanings:

▸ = Relay is energized

0 = Relay is de-energized

A = Alarm relay (see page 91 about alarms)

S = Sampler relay

T = Totalizing relay

How to reset the relay parameters only to factory defaults

To reset all relay parameters to their factory defaults, do the following:

1. Navigate to: SETUP / [CONTROLLER /] OUTPUT / RELAY / Reset RL param
2. If you wish to proceed, press the **red (ENTER)** button once.
   (Otherwise, use the **Esc** button to exit to the RELAY menu).
3. Wait until the "Please wait..." message disappears.
4. Press the **Esc** button to exit to the RELAY menu.

Note

- Setting the relays to their factory default state in this way does NOT reset any other parameters to their default state.

How to set-up an on/off point control relay

Note

- Relays are frozen while the MCU900 Series control unit is in **Program** mode, preventing all relay operations apart from Totalizer and Sampler relays.

Relay outputs 1 to 4 can be programmed to be an On/Off Point control relay.

Menus:
SETUP / [CONTROLLER /] OUTPUT / RELAY / RELAY 1, / RELAY 2, etc.

Relay 1 (RL1)

- When relay RL1 mode (**P410**) is **Set Point**:
  relay RL1 is energized at **P411** (on point) and de-energized at **P412** (off point)

Relay 2 (RL2)

- When relay RL2 mode (**P420**) is **Set Point**:
  relay RL2 is energized at **P421** (on point) and de-energized at **P422** (off point)

Relay 3 (RL3)

- If relay RL3 mode (**P430**) is **Set Point**:
  relay RL3 is energized at **P431** (on point) and de-energized at **P432** (off point)

Relay 4 (RL4)

- If relay RL4 mode (**P440**) is **Set Point**:
  relay RL4 is energized at **P441** (on point) and de-energized at **P442** (off point)

In a basic *emptying* application, the **On Point** (e.g. **P411**) is programmed to be *greater than* the **Off Point** (e.g. **P412**). The Set Point relay energizes when the control unit PV value (**D800**) exceeds the **On Point** and de-energizes when the PV value drops below the **Off Point**.

In a basic *filling* application, the **On Point** (e.g. **P411**) is programmed to be *less than* the **Off point** (e.g. **P412**). The Set Point relay energizes when the control unit PV value (**D800**) falls below the **On point** and de-energizes when the PV value rises above the **Off Point**.

There are set point relays modes for the control unit SV value (**D801**), TV value (**D802**) and FV value (**D803**). For details of these **D80*** parameters, see "Optional change: transmitter input channel settings (advanced users)" on page 43.

Relay safeguard options

Menus:
SETUP / [CONTROLLER /] OUTPUT / RELAY / RELAY 1, / RELAY 2, etc.

P413 RL1 Min On (Factory default: 0:00 m:s)

Defines the minimum time (minutes and seconds) that relay RL1 will stay energized before de-energising. This is an optional override (safeguard) to allow sufficient time for connected equipment to respond.

P414 RL1 Max On Factory default: 0:00 m:s)

Defines the maximum time (minutes and seconds) that relay RL1 will stay energized before de-energising. This is an optional override (safeguard) to prevent overuse of connected equipment.

P415 RL1 Min Off (Factory default: 0:00 m:s)

Defines the minimum time (minutes and seconds) that relay RL1 will stay de-energized before energising. This is an optional override (safeguard) to avoid overuse of connected equipment.

P423 to **P425** are the equivalents for relay RL2.

P433 to **P435** are the equivalents for relay RL3.

P443 to **P445** are the equivalents for relay RL4.

P453 to **P455** are the equivalents for relay RL5.

Other relay modes

Table 4-4 on page 72 is a list of all relay modes. Relay modes automatically enable and disable special control functions, special alarms and pumped volume totalizing as shown in Table 4-5 on page 73. Descriptions of relay modes and the auxiliary functions follow Table 4-5.

Table 4-4. Relay modes

Relay Mode	Purpose of Relay Mode	Auxiliary functions (Table 4-5)
None	Relay is not used	No
Set point SV	On/Off Point control using SV (D801) – see "How to set-up an on/off point control relay" on page 70.	Yes
Set point TV	On/Off Point control using TV (D802) – see "How to set-up an on/off point control relay" on page 70.	Yes
Set point FV	On/Off Point control using FV (D803) – see "How to set-up an on/off point control relay" on page 70.	Yes
Assist	Duty Assist, On/Off Point Control and Auto Sequence – see "Duty Assist relay with common off points" on page 74. – see "Duty Assist with split off points" on page 76. – see "Auto-sequence (Mobrey MCU901 and MCU902 only)" on page 84.	Yes
Stby com off	Duty Standby, Common Off and Auto Sequence – see "Standby, Common Off mode relay" on page 78 – see "Auto-sequence (Mobrey MCU901 and MCU902 only)" on page 84.	Yes
Stdby split off	Duty Standby, Split Off and Auto Sequence – see "Standby, Split Off mode relay" on page 80. – see "Auto-sequence (Mobrey MCU901 and MCU902 only)" on page 84.	Yes
Digital Input 1	Relay energizes while Digital Input 1 (IN1) is active.	Yes
Digital Input 2	Relay energizes while Digital Input 2 (IN2) is active.	Yes
Sampler	Relay outputs sampler pulses – see "Sampler mode relay" on page 82.	No
RoC	Relay is energized if the rate of change of the control unit PV is out-of-limits – see "Rate of Change mode relay" on page 83.	Yes
Digital input 1+2	Relay is energized while Digital Input 1 (IN1) and 2 (IN2) are both active	Yes
Off	Relay is always de-energized	No
Set Point	On/Off Point Control using PV (D800) – see "How to set-up an on/off point control relay" on page 70.	Yes
Alarm	Relay is allocated to alarm indication duty – see "Set-up alarms" on page 91 for details of alarm handling.	Yes
Hi or Lo Alarm	High alarm limit (using On/Off Point Control): – The On Point must be greater than the Off Point. – Relay energizes when the PV (D800) is greater than the On Point. – Relay de-energizes when the PV (D800) is less than the Off Point.	Yes
	Low alarm limit (using On/Off Point Control): – The On Point must be less than the Off Point. – Relay energizes when the PV (D800) is less than the Off Point. – Relay de-energizes when the PV (D800) is greater than the On Point.	
	An "A" is shown by the RL1 icon status (on the Full PV Display) when there is a high or low alarm. (The section "Set-up alarms" on page 91 is not applicable).	
Totalizer	Relay outputs totalizer pulses (MCU901 only) – see "Totalizer mode relay" on page 82.	No
Totalizer 1	Relay outputs totalizer 1 pulses (MCU902/MCU90F only) – see "Totalizer mode relay" on page 82.	No
Totalizer 2	Relay outputs totalizer 2 pulses (MCU902/MCU90F only) – see "Totalizer mode relay" on page 82.	No
Fault	Indicate fault condition by de-energizing relay – see "Fault mode relay" on page 82.	No
Custom	To set-up a custom relay operation, see "Custom mode relay" on page 86.	No
PV limits	Relay energizes while control unit PV value (D800) is within on/off point limits. – see "PV Limits mode relay" on page 83.	Yes
On	Relay is always energized	No

Table 4-5. Auxiliary functions valid for a given relay mode

RELAY MODE	SPECIAL CONTROL FUNCTIONS						SPECIAL ALARMS					
	SET POINTS	(1) AUTO SEQUENCE	ENERGY SAVING	SCUM LINE (1)	PUMP DOWN (1)	CUSTOM	RELAY OPS	RELAY RUN TIME	NO ACTIVITY	RISING LEVEL	PUMP EFFICIENCY	PUMPED VOLUME
None												
Set point (PV)	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	
Set Point (SV)	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	
Set Point (TV)	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	
Set Point (FV)	Yes		Yes	Yes	Yes		Yes	Yes	Yes		Yes	
Assist	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Stby Com-off	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Stby Split-off	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Digital Inputs							Yes	Yes	Yes			
Sampler												
Rate change	Yes						Yes	Yes	Yes			
Off												
Alarm	Yes											
Hi / Lo Alarm	Yes											
Totalizer												
Fault												
Custom												
PV Limits	Yes						Yes	Yes	Yes			
On												
	page 70	page 84	page 85	page 85	page 85	page 86	page 88	page 88	page 88	page 89	page 89	page 90

(1) Option available on the Mobrey MCU901 and MCU902 only.

Duty Assist relay with common off points

This function requires two or more **Assist** mode relays. Two or more of these relays can be energized at the same time (assisting), and they all de-energize at a **common off point**.

An **Assist** relay uses its **On Point** and **Off Point** parameters in a similar way to a Set Point mode relay. A typical application would be emptying a wet well / lift station.

The worked example here illustrates how the function works. To keep the example simple, the auto-sequencing options are not considered.

Example wet well / lift station application (emptying operation due to rising level) using assist mode relays and common off points

Consider an application with two relay outputs, RL1 and RL2, connected to individual pumps in a wet well/lift station. The control unit PV value (**D800**) is a level measurement in metres (m).

- In Figure 4-28, both Pump 1 and Pump 2 are off because the liquid level is at a satisfactory level, below 5 m
- When the level rises above 5 m (On point, P411), the relay RL1 is energized to start Pump 1 (Figure 4-29)
- If the level continues to rise and is above 8 m (On point, P421), relay RL2 is energized to start Pump 2 and assist Pump 1. Relay RL1 stays energized to keep Pump 1 pumping (Figure 4-30)
- Pump 1 and Pump 2 continue to pump down until the level falls to below 2 m (Off Point, P412 and P422), at which relays RL1 and RL2 de-energize to switch off both pumps (Figure 4-31).

  In this emptying application, the **common off** point is **P412** (Off point, relay RL1) and **P422** (Off point, relay RL2), both of which are at the 2 m level.

Note

- If Pump 1 had kept the level below 8 m, it would stay switched on until the level is 2 m. Safeguards to prevent over-use of a pump are in "Relay safeguard options" on page 71.

Figure 4-28. Both Pump 1 and Pump 2 are off (the level is okay)

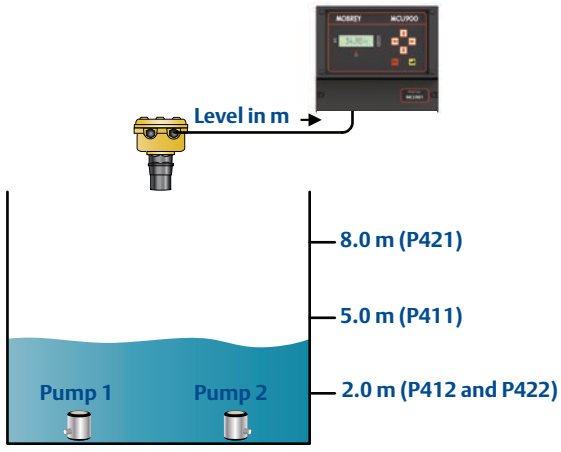


Figure 4-29. Pump 1 is on (the rising level is above 5 m)

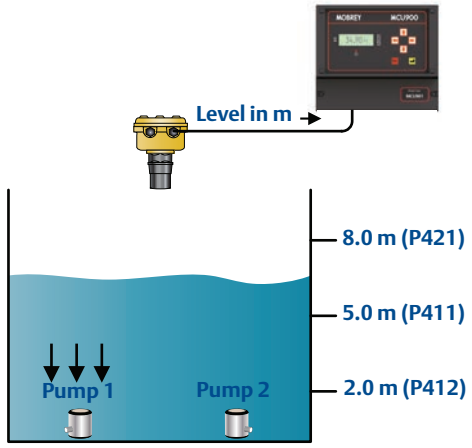


Figure 4-30. Pump 1 and Pump 2 are on (the rising level is above 8 m)

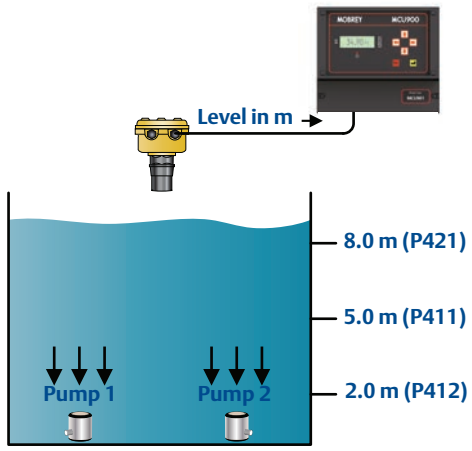
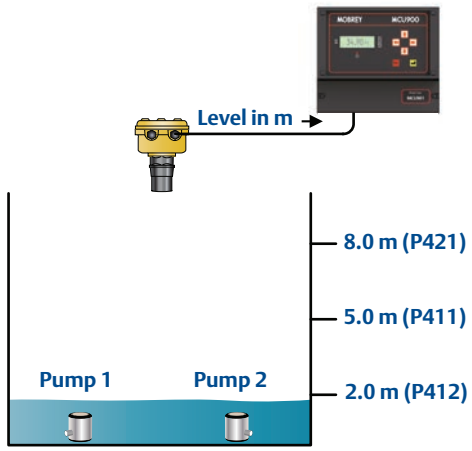


Figure 4-31. Pump 1 and Pump 2 are off (the falling level is below 2 m)



Duty Assist with split off points

This function requires two or more **Assist** mode relays. Two or more of these relays can be energized at the same time (assisting), and they all de-energize at a **split off points**.

An **Assist** relay uses its **On Point** and **Off Point** parameters in a similar way to a Set Point mode relay. A typical application would be emptying a wet well / lift station.

The worked example here illustrates how the function works. To keep the example simple, the auto-sequencing options are not considered.

Example wet well / lift station application (emptying operation due to rising level) using assist mode relays and split (separate) off points

Consider an application with two relays, RL1 and RL2, connected to individual pumps in a wet well. The control unit PV value (**D800**) is a liquid level measurement in metres.

- In Figure 4-32, both Pump 1 and Pump 2 are off because the liquid level is at a satisfactory level, below 5 m
- When the level exceeds 5 m (On Point, P411), relay RL1 is energized to start Pump 1 (Figure 4-33)
- When the level exceeds 8 m (On Point, P421), relay RL2 is energized to start Pump 2 and assist Pump 1. Relay RL1 stays energized to keep Pump 1 pumping (Figure 4-34)
- When the level falls to below 3.5 m (Off point, P422), relay RL2 de-energizes to switch off Pump 2 (Figure 4-35)
- When the level falls to below 2 m (Off point, P412), relay RL1 de-energizes to switch off Pump 1

Note

- If Pump 1 keeps the level below 8 m, it would stay switched on until the level is 2 m. Safeguards to prevent overuse of pumps are in "Relay safeguard options" on page 71

Figure 4-32. Both Pump 1 and Pump 2 are off (the level is okay)

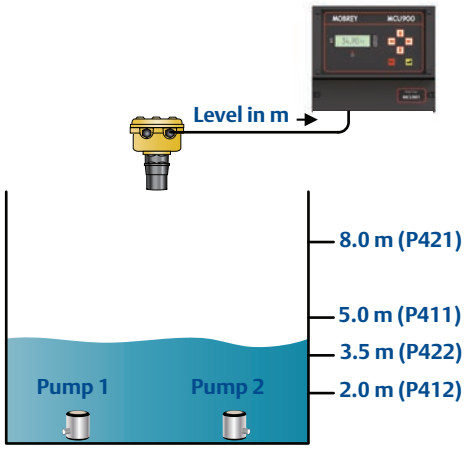


Figure 4-33. Pump 1 is on (the rising level is above 5 m)

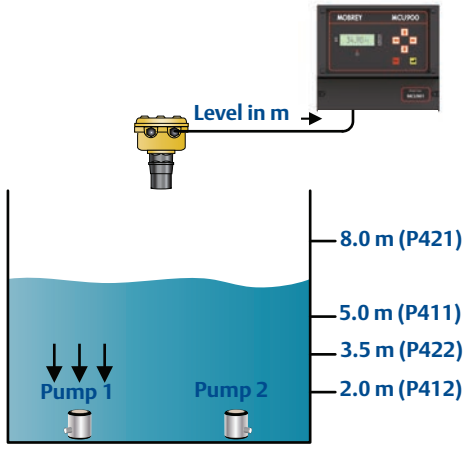


Figure 4-34. Both Pump 1 and Pump 2 are on (the rising level is above 8 m)

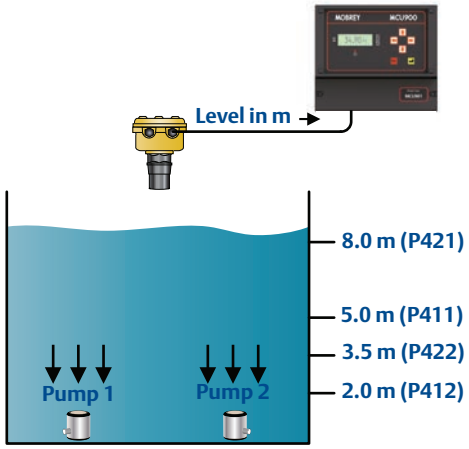
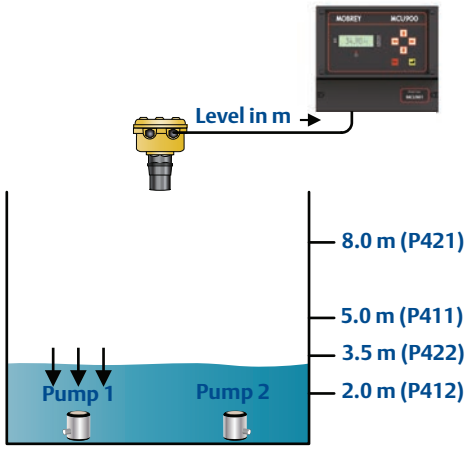


Figure 4-35. Pump 1 on and Pump 2 is off (the falling level is below 3.5 m)



Standby, Common Off mode relay

This function requires two or more **Standby, Common Off** mode relays. Only one of these relays is energized at any one time and the others are on standby to take over when needed.

A **Standby, Common Off** relay uses its **On Point** and **Off Point** parameters in a similar way to a Set Point mode relay. A typical application would be emptying a wet well / lift station.

The worked example here illustrates how the function works. To keep the example simple, the auto-sequencing options are not considered.

Example wet well application (emptying operation due to rising level) using standby, common off point relays

Consider an application with two relay outputs, RL1 and RL2, connected to individual pumps in a wet well. The control unit PV value (**D800**) is a liquid level measurement in metres (m).

- In Figure 4-36, both Pump 1 and Pump 2 are off because the liquid level is at a satisfactory level, below 5 m
- When the level rises above 5 m (On point, P411), the relay RL1 is energized to start Pump 1 (Figure 4-37)
- If the level continues to rise and is above 8 m (On point, P421), the relay RL2 is energized to start Pump 2. Relay RL1 is de-energized to switch off Pump 1 (Figure 4-38)
- Pump 2 continues to pump until the level falls below 2 m (Off Point, P412), at which relay RL2 will de-energize to switch off Pump 2. (Pump 1 is already switched off).

  In this emptying application, the **common off** point is **P412** (Off point, relay RL1) and **P422** (Off point, relay RL2), both of which are at the 2 m level.

Note

- If Pump 1 had kept the level below 8 m, it would stay switched on until the level is 2 m. Safeguards to prevent over-use of a pump are in "Relay safeguard options" on page 71.

Figure 4-36. Both Pump 1 and Pump 2 are off (the level is okay)

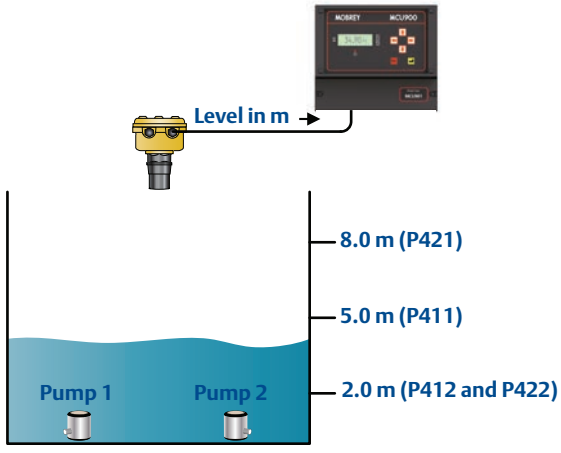


Figure 4-37. Pump 1 is on (the rising level is above 5 m)

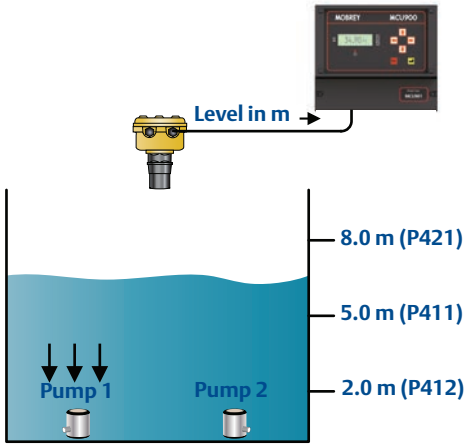
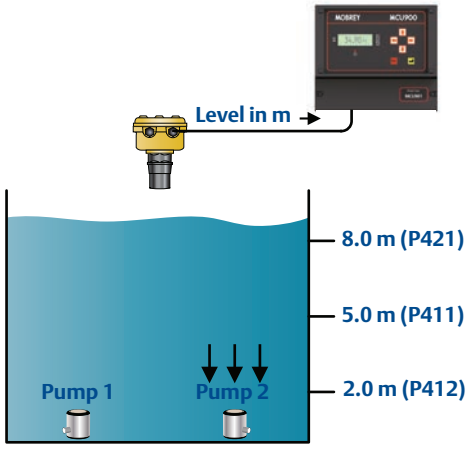


Figure 4-38. Pump 1 is off and Pump 2 is on (the rising level is above 8 m)



Standby, Split Off mode relay

This function requires two or more **Standby, Split Off Point** mode relays. Only one of these relays is energized at any one time and the others are on standby to take over when needed.

A **Standby, Split Off Point** relay uses its **On Point** and **Off Point** parameters, just like a Set Point mode relay. A typical application would be emptying a wet well / lift station.

The worked example here illustrates how the function works. To keep the example simple, the auto-sequencing options are not considered.

Example wet well / lift station application (emptying operation due to rising level) using standby, split off point relays

Consider an application with two relays, RL1 and RL2, connected to individual pumps in a wet well. The control unit PV value (**D800**) is a liquid level measurement in metres.

- In Figure 4-39, both Pump 1 and Pump 2 are off because the liquid level is at a satisfactory level, below 5 m
- When the level exceeds 5 m (On Point, P411), relay RL1 is energized to start Pump 1. (Figure 4-40)
- When the level exceeds 8 m (On Point, P421), relay RL2 is energized to start Pump 2. Relay RL1 is de-energized to switch off Pump 1 (Figure 4-41)
- When the level falls to below 5 m (Off point, P422), relay RL2 de-energizes to switch off Pump 2. Relay RL1 is energized to switch on Pump 1 (Figure 4-42)

  In this emptying application, the switch off point for Pump 2 is 5 m; the On Point for relay 1 **P411** (On point, relay RL1) is used. **P422** (Off point, relay RL2) is ignored.

- When the level falls below 2 m (Off point, P412), relay RL1 de-energizes to switch off Pump 1

Note

- If Pump 1 keeps the level below 8 m, it would stay switched on until the level is 2 m. Safeguards to prevent overuse of pumps are in "Relay safeguard options" on page 71

Figure 4-39. Both Pump 1 and Pump 2 are off (the level is okay)

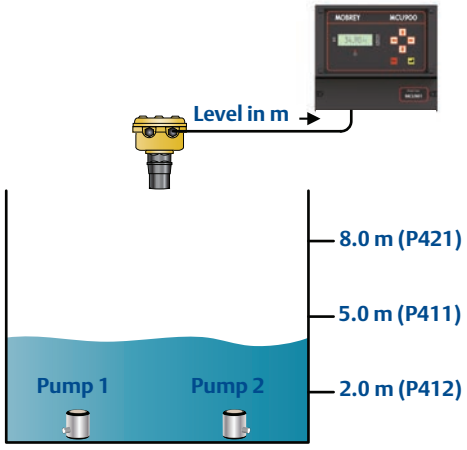


Figure 4-40. Pump 1 is on (the rising level is above 5 m)

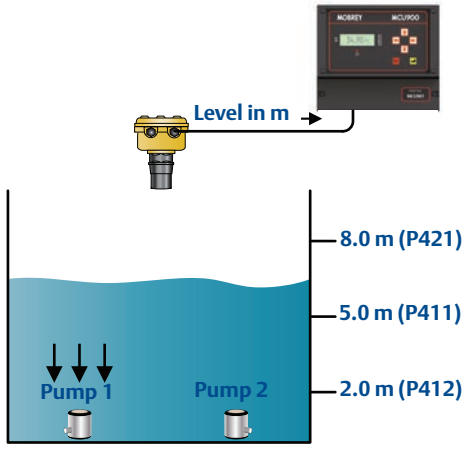


Figure 4-41. Pump 1 is off and Pump 2 is on (the rising level is above 8 m)

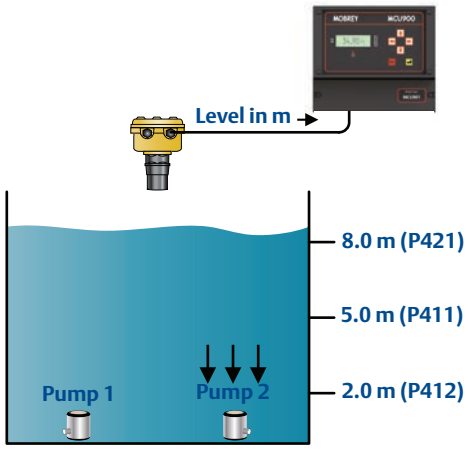
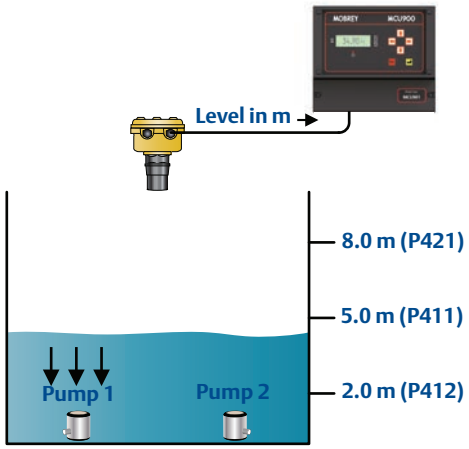


Figure 4-42. Pump 1 is on and Pump 2 is off (the falling level is below 5 m)



Totalizer mode relay

Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

A Totalizer relay can output a pulse for each time that the internal totalizer count (**D828**) increments. The duration of the pulse may set using parameter **P534**.

P534 Pulse Width (Factory default is 100)

- The duration controls both the 'On' time and the 'Off' time - i.e. the pulse width - and may be set to a value between 10 ms and 2.5 seconds in steps of 10ms.

Note

- If the totalizer count is running faster than the relay can produce pulses, an internal accumulator stores the excess pulses. The stored excess pulses are output by the Totalizer relay after the totalizer count rate reduces.

Sampler mode relay

Sampler relays output pulses at a slower rate than a Totalizer relay. The Sampler relay can be used as a coarse totalizer or as a trigger to an external event.

Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

P535 Sampler Factor (Factory default is 0)

- This is for defining the frequency of the Sampler pulse. For example, a value of 100 means that the Sampler relay outputs a single pulse for every 100th increment to the Totalizer Count (**D828/D829**)
- The pulse width is the same as selected for the Totalizer relay (**P534**)

Note

- For information on setting up the totalizer, see page 95 onwards.

Fault mode relay

Fault relays de-energize when a particular fault condition exists. Parameter **D831** shows a list of active faults. Table 4-8 on page 94 has a summary of reporting methods for faults.

Menu: SETUP / [CONTROLLER /] OUTPUT / FAULT

P560 System Fault (Factory default is **Both**)

- Fault relay de-energizes while there is a control unit fault and the option is **Both** or **Relay**

P561 CU Temp Fault (Factory default setting is **None**)

- Fault relay de-energizes while the CPU temperature rises above 65 °C and the option is **Both** or **Relay**. Read-only parameter **D844** shows the live temperature reading

P562 Xmtr Fault (Factory default setting is **None**)

- Fault relay de-energizes while a HART transmitter signals a fault and the option is **Both** or **Relay**

P563 Digital Input (Factory default setting is **None**)

- Fault relay de-energizes while digital input IN1 or IN2 is triggered and the option is **Both** or **Relay**
- See "Digital inputs IN1 and IN2" on page 63 for how to select the **Fault** action required for this feature

Note

- Faults can be indicated using the output current if the **Current** or **Both** options are selected (see "Set-up the current output" on page 68)

PV Limits mode relay

Menus:
SETUP / [CONTROLLER /] OUTPUT / RELAY / RELAY 1, / RELAY 2, etc.

This relay mode uses the relay **On Point** and **Off Points** (e.g. **P411** and **P412**) as high and low limit alarms for the control unit PV value (**D800**). The points can be in any order of value.

The relay is energized while the PV value exceeds the higher limit point value or while it is below the lower limit point value.

Rate of Change mode relay

Menus:
SETUP / [CONTROLLER /] OUTPUT / RELAY / RELAY 1, / RELAY 2, etc. and
MONITOR / [CONTROLLER /] READINGS / Rate of Change

A rate of change value for the control unit PV value (**D800**) is calculated every 5 seconds in units of PV per minute:

$D809 = (PV_{now} - PV_{5\ seconds\ ago}) * 12$

The On and Off points of a **Rate of Change (RoC)** mode relay are used as high and low limits for read-only parameter **D809**. Limit values are in units of PV per minute (PV/min) and can be in any order of value. The relay is energized while **D809** exceeds the higher limit value or falls below the lower limit value.

Typically, where the PV value is a liquid level measurement, the RoC relay can be used to warn of a quickly rising or falling liquid level. Alternatively, the RoC mode relay can be used for controlling the rate of liquid flow.

For further uses of **D809**, see "Pump Efficiency alarm (Mobrey MCU901 and MCU902 only)" on page 89 and "Pumped volume totalizing" on page 90.

Pump On Delay

Menu: SETUP / [CONTROLLER /] OUTPUT / RELAY / OVERRIDES

P499 Pump On Delay (Factory default is **"**3 s**"**)

- This function is to prevent pumps from all being switched on simultaneously, which could cause a massive surge
- When multiple relays are used for pump control (or as a set point) and power is lost, this function provides a delay of 0 up to 9 seconds (3 seconds by default) for the second, third, fourth, and fifth relay when power is re-established

Auto-sequence (Mobrey MCU901 and MCU902 only)

(Special Control Function – see Table 4-5 on page 73 for a full list)

Optional automatic rotation of the leading (most used) relay can be applied to Assist or Standby mode relays. To use these options, two or more relays must have the same mode. The lowest numbered relay is initially the lead relay.

Note

- The rotation of relays is performed without the actual swapping of values between relay parameters.

P270 Auto Seq Enable (Factory default is **"**Off**"**)

- Select a rotation auto-sequence. All options are summarized in Table 4-6

P271 Auto Seq Qual (Factory default is 0)

- This defines the threshold (e.g. how many starts) before applying an auto-sequence to rotate the 'lead' to the next relay with the same mode

Table 4-6. Auto-sequence options

Option	Rotation basis
Standby Starts	For Standby mode relays only - rotation is based on how many times the 'leading' relay has been energized compared to parameter **P271**.
Stdby On Time	For Standby mode relays only - rotation is based on the hours that the 'leading' relay has been energized compared to parameter **P271**.
Stdby Ratio T (1)	For two Standby mode relays only - rotation is based on the ratio of ON time for two relays compared to **P271**.
Stdby Ratio S (1)	For two Standby mode relays only - rotation based on the ratio of starts (times energized) compared to **P271**.
Assist Starts	Rotation of 'leading' Assist mode relay is based on how many times it has been energized compared to **P271**.
Assist On Time	Rotation of 'leading' Assist mode relay is based on the hours that it has been energized compared to **P271**.
Assist Ratio T (1)	For two Assist mode relays only - rotation based on the ratio of ON time for the two relays compared to **P271**.
Assist Ratio S (1)	For two Assist mode relays only - rotation based on the ratio of starts (times energized) compared to **P271**.
Off	No rotation required.

(1) Ratio is based on the first two lowest-numbered relays with the same mode.

Energy saving

(Special Control Function – see Table 4-5 on page 73)

Menu: SETUP / [CONTROLLER /] OUTPUT / RELAY / OVERRIDES

P275 Engy Save Strt (Factory default is 0:00 h:m)

- Set the time of day at which selected relays (**P276**) will energize until each relay Off Point is reached. The energy saving start time is valid for one minute; if missed by the MCU900 Series control unit being in **Program** mode, no action is taken when subsequently put into **Run App** mode.

P276 Engy Save RL (Factory default is 00000)

- Select relays for the operation associated with parameter **P275**
- Each digit represents a relay. Relay RL1 is selected by editing the first digit to be a “1”. Similarly, relay RL5 is selected with the fifth digit. To de-select a relay, change the appropriate digit back to a “0”

Scum line prevention (Mobrey MCU901 and MCU902 only)

(Special Control Function – see Table 4-5 on page 73 for a full list of auxiliary relay functions)

This special control function is normally used with a pump control application to provide a small variance in the start and stop level for the pump. It will help to prevent a build-up of scum on the side of a wet well or sump.

Menu: SETUP / [CONTROLLER /] OUTPUT / RELAY / OVERRIDES

P277 Scum line var (Factory default is 0.0)

- This parameter defines a maximum variance in the On Points and Off Points of selected relays (**P278**). The variance is entered in the units of the On/Off Point, spaced in ten equal increments within the On Point and Off Point limits. Each time the selected relays (**P278**) de-energize, the variance moves on an increment

P278 Scum line RL (Factory default is 00000)

- Select relays for the operation associated with parameter **P277**
- Each digit represents a relay. Relay RL1 is selected by editing the first digit to be a “1”. Similarly, relay RL5 is selected with the fifth digit. To de-select a relay, change the appropriate digit back to a “0”

Pump-down (Mobrey MCU901 and MCU902 only)

(Special Control Function – see Table 4-5 on page 73 for a full list)

In a pump-down application, the lowest relay Off Point ('pump off' level) is normally a fixed level above the Transmitter Bottom Reference point. However, it is sometimes required to make the pumps continue to run for a period past the Off Point or run down the level to the Transmitter Bottom Reference point. This can clear a sump of sludge that may have collected at the bottom.

Pump-down can be initiated automatically at pre-set intervals. A digital input can also initiate pump-down at any time and this will re-set the interval before the next pump-down.

Pump-down automatically stops when the control unit PV (**D800**) is zero or after 20 minutes if a duration (**P274**) has not been programmed, whichever is the shorter period.

Note

- For details on configuring a digital input to initiate a pump-down operation, see "Digital inputs IN1 and IN2" on page 63

Menu: SETUP / [CONTROLLER /] OUTPUT / RELAY / OVERRIDES

The relay mode must be **Set point**, **Assist** or, **Standby**, and parameters **P272** to **P274** edited to set-up the pump down operation.

P272 Pump down RL (Factory default is 00000)

- This is for selecting relays for a pump-down operation
- Each of the five digits represents a relay. Relay RL1 is selected by editing the first digit to a "1". Similarly, relay RL5 is selected by editing the fifth digit. To de-allocated, edit the appropriate digit back to a "0"

P273 Pump down Int (Factory default is 000:00 h:m)

- This defines a fixed interval (hours and minutes) between pump-downs

P274 Pump down Dur (Default setting is 00:00)

- This defines the period (hours and minutes) that the relay will remain energized for the pump-down. Safeguards may extend or reduce this period (see "Relay safeguard options" on page 71)

D845 Next pump-down h:m (Factory default is 000:00)

- This shows the time remaining before the next pump-down is started. The display shows 000:00 if a pump-down is in progress or if it is not set-up

Custom mode relay

(Special Control Function – see Table 4-5 on page 73 for a full list)

A custom mode relay is typically used together with a secondary external device to provide a voltage-free contact connected to one of the controller digital inputs (IN1 or IN2).

For example, this function may be used to provide a low flow cut-off for a pump control if the pump is provided with a flow/no-flow switch. A second relay contact assigned to pump control would then be wired in series with the Custom mode relay to provide the low flow cut-off.

Menu: SETUP / [CONTROLLER /] APPLICATION / CUSTOM

P250 Start On (Factory default is **"**None**"**)

- Relay energizes when the selected condition is true. See also Table 4-7 on page 87

P251 Stop On (Factory default is **"**None**"**)

- Relay de-energizes when the selected condition is true. See also Table 4-7 on page 87

P252 Stop If (Factory default is **"**None**"**)

- Relay de-energizes when the selected condition is true. See also Table 4-7 on page 87. **P252** is a fail-safe for **P251**

P253 Start Time (Factory default is **"**7:00**"** - i.e. 7AM)

- This defines the clock time for when a Custom mode relay operation will begin (if **P250** = **Time**) or end (if **P251** = **Time**)

P254 Interval (Factory default is **"**1:00**"** i.e. 1hr 0min)

- This is for defining the interval for repeating a Custom mode relay operation. **P255** and **P256** are for setting up a second starting time and an associated interval

P257 Max Retries (Factory default is 10)

- This defines the maximum number of failed attempts to perform Custom mode relay operations before it is deemed an alarm condition.
- The alarm condition can happen if the control unit is in **Program** mode, which prevents all Custom mode relay operations from starting. Also, it can happen when the maximum time for an energized relay (relay safeguard, page 71) has been reached and is preventing a Custom mode relay operation from completing. For alarm indication options, see "Set-up alarms" on page 91

Table 4-7. P250/P251/P252 options

Options	Purpose of option	Start on (P250)	Stop on (P251)	Stop if (P252)
None	Switched off.	Yes	Yes	Yes
Time	**P253** and **P254** determine when a Custom mode relay is to be energized.	Yes	Yes	-
PV > Level	Energize a Custom mode relay when the control unit PV value (D800) is greater than the relay On Point.	Yes	-	-
PV < Level	De-energize a Custom mode relay when the control unit PV value (D800) less than the relay On point.	-	Yes	Yes
Ext Trig(1)(2)	Energize a Custom mode relay when a digital input is active.	Yes	Yes	Yes
Ext Trig Xs(1)(2)	When a Digital Input is active, de-energize a Custom mode relay after X seconds delay.	-	-	Yes

(1) This does not require Digital Input IN1 or IN2 to be allocated an action
(2) Abbreviations: "Ext Trig" = External Trigger (Digital Input)

Note

- For any of the alarms below to be indicated by a relay or current output, an indication method must be selected. See "Alarm indication selection" on page 91 for details

Relay Operations alarm

(Special alarm – see Table 4-5 on page 73 for a full list of auxiliary relay functions)

Menu: SETUP / [CONTROLLER /] APPLICATION / ALARM

P491 RL operations (Factory default is 0)

- It is an alarm condition when the number of operations done by a selected relay (**P492**) is higher than the number in **P491**
- Relay operation counters parameters **D811** to **D815** are in the MONITOR menu. See also "Health checking the MCU900 Series control unit" on page 110
- For alarm indication options, see "Set-up alarms" on page 91

P492 RL ops rly sel (Factory default is "Disabled")

- Select the relay for the monitoring operation associated with parameter **P491**

Relay Run-time alarm

(Special alarm – see Table 4-5 on page 73 for a full list of auxiliary relay functions)

Menu: SETUP / [CONTROLLER /] APPLICATION / ALARM

P493 RL runtime (Factory default is 0:00 h:m = OFF)

- It is an alarm condition when a relay, selected by **P494**, has been energized for longer than the period (hours and minutes) set by **P493**
- Run-time counters parameters **D821** to **D825** are in the MONITOR menu. See also "Health checking the MCU900 Series control unit" on page 110
- For alarm indication options, see "Set-up alarms" on page 91

P494 RL run rly sel (Factory default is "Disabled")

- Select the relay for the monitoring operation associated with parameter **P493**

Note

- For any of the alarms below to be indicated by a relay or current output, an indication method must be selected. See "Alarm indication selection" on page 91 for details

No Activity alarm

(Special alarm - see Table 4-5 on page 73 for a full list of auxiliary relay functions)

Menu: SETUP / [CONTROLLER /] APPLICATION / ALARM

P497 No Activity Del (Factory default is 0:00 h:m)

- It is an alarm condition if there is no relay activity for the period (hours and minutes) defined by parameter **P497**. Relays are selected for monitoring using parameter **P498**. The alarm condition is cleared when any of the monitored relays are energized
- For alarm indication options, see "Set-up alarms" on page 91

P498 No Activity RL (Factory default is 00000)

- Select relays for the relay inactivity monitoring operation
- Each digit represents a relay. Relay RL1 is selected for monitoring by editing the first digit to be a “1”. Similarly, relay RL5 is selected with the fifth digit. To de-select a relay, change the appropriate digit back to a “0”

Rising Level alarm

(Special alarm – see Table 4-5 on page 73 for a full list of auxiliary relay functions)

Menu: SETUP / [CONTROLLER /] APPLICATION / ALARM

P490 R Lev alrm del (Factory default is 0:00 m:s)

- The Rising Level alarm requires a minimum of one Assist or Standby mode relay.

  If any Standby relay is energized, monitoring of the rising level is activated. For Assist relays, they must all be energized for monitoring of the rising level to be activated.

  A timed delay (**P490**) starts after the monitoring is activated. If the level is still rising after the delay time has expired and the calculated rate of change of the control unit PV (**D800**) is positive, the result is a Rising Level alarm condition. The alarm condition stops as soon as the rate of change is negative, indicating a falling level.

- For the Rising Level alarm to be indicated by a relay output or the current output, a method must be selected. See “Set-up alarms” on page 91
- See also “Rate of Change mode relay” on page 83

Pump Efficiency alarm (Mobrey MCU901 and MCU902 only)

(Special alarm – see Table 4-5 on page 73 for a full list of auxiliary relay functions)

The pump efficiency feature allows an alarm to be indicated (**P550**, **P4*1**) if the calculated pump efficiency falls below a defined limit (**P495**).

Menu: SETUP / [CONTROLLER /] APPLICATION / ALARM

P495 Pump effy limit (Factory default is 0% = OFF)

- It is an alarm condition while the calculated pump efficiency is below the limit defined by P495. The pump efficiency calculation is based on the rate of change of the control unit PV (**D800**) and is independently monitored for each selected relay (**P496**)
- Pump efficiency values for relays are saved in **D861** to **D864**, located in the MONITOR menu. See also “Health checking the MCU900 Series control unit” on page 110.

P496 Pump effy RL (Factory default is 0000)

- Select relays for pump efficiency limit monitoring operation
- Each digit represents a relay. Relay RL1 is selected by editing the first digit to be a “1”. Similarly, relay RL4 is selected with the fourth digit. (Relay RL5 does not support this feature.) To de-select a relay, change the appropriate digit to a “0”

Pump efficiency (PE) is calculated using the rate of change (RoC) of the control unit PV while a relay is energized. The PE value is saved in **D86***; the “*” is the number of the relay (1 to 4)

The calculation assumes that liquid continues to enter the well or tank at the rate just prior to the relay energizing (pump starting).

The control unit continuously calculates the rate of change, sampling a new control unit PV every 5 seconds (as described in Section "Rate of Change mode relay" on page 83).

Over the next 9 pump starts, a further 9 change of RoC values are stored such that the control unit can then calculate an average value in change of RoC. This average value, "RoC100" is then taken as being equivalent to the pump operating at 100% efficiency. A value of 100% is then stored in D86*.

Each subsequent pump start, and change in RoC thereafter, is used in a rolling average calculation for a new average value in change of RoC, RoCnew, which is then compared to the previous value "RoC100" and a new PE percentage value calculated using:

PE % = (RoCnew / RoC100) * 100

If the resulting PE is greater than 100%, the RoC100 is updated to the new value and the PE is re-stated as 100% based on this new value.

If the resulting PE is less than 100%, then the PE is calculated as above and stored in D86*

If the PE is below the limit set (**P495**), the PE alarm condition is true. To indicate an alarm by Relay or Current Output, a method must be selected (see "Set-up alarms" on page 91).

Note

- The alarm condition is automatically cleared if the calculated PE rises above the limit (P495) by 5% or more

Pumped volume totalizing

(Totalizer Option – see Table 4-5 on page 73 for a full list of auxiliary relay functions)

This function is for calculating the total throughput in a contents volume application.

The control unit monitors the change in volume when no pumps are running i.e. when any Assist or Standby mode relay is de-energized. It calculates the rate of change (RoC) of the control unit PV (**D800**) every five seconds and then converts it to a rate of change per minute for displaying as parameter **D809**.

When a pump is turned on, the control unit assumes that the rate of inflow remains the same as it was just before starting the pumps. The RoC value (**D809**) is frozen while the pumps are on i.e. when any Assist or Standby mode relay is energized.

To totalize pumped volume, the control unit PV (**D800**) must be in volume units so that the RoC value (**D809**) is in units of volume per minute. The control unit integrates this volume every second and increments the totalizer for every integer unit.

If the RoC value (**D809**) is 12 m^3 per minute and the Total factor parameter (**P530**) is set to 1.0 (m^3), the Totalizer count (**D828**) increments every five seconds ($^1/_{12}$th of a minute).

Note

- The Totalizer Wizard can be used to set-up pumped volume totalizing.

Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

P530 Total factor (Factor default is 0.0)

- One count is added to the Totalizer count (**D828**) for a quantity defined by **P530**

P531 Total units (Factory default is "None")

- Pumped volume totalizing is enabled by the totalizer units (**P531**) being set to **PVol**. (This parameter also defines the display units for parameter **D828**).

Note

- For other associated parameters, see "Set-up totalizing on the Mobrey MCU901 control unit" on page 95.

4.5.22 Set-up alarms

Alarms

The MCU900 Series control unit can detect the following alarm conditions:

- Control unit Primary / Process Value (PV) is out-of-limits
- Current Output saturated
  (Standard: ≤ 3.9mA or ≥ 20.8mA, NAMUR NE43: ≤ 3.8mA or ≥ 20.5mA)
- Logging memory filling (Mobrey MCU90F)
- Logging memory full (Mobrey MCU90F)
- Digital input is configured to force an alarm when active
- Maximum number of failed Custom relay operation attempts
- Current Input saturated
- Rising liquid level
- Relay operation count limit exceeded
- Relay run time limit exceeded
- Low pump efficiency (on the MCU901 and MCU902 only)
- Relay inactivity

Parameter **D830** shows a list of active alarms. Alarms are indicated using relay outputs and the current output. Table 4-8 on page 94 has a summary of reporting methods for alarms.

Alarm indication selection

Menu: SETUP / [CONTROLLER /] OUTPUT / ALARM

For each alarm, there is a dedicated parameter in the ALARM menu for selecting the method of indication for that alarm. Options for parameters **P540** to **P551** are:

- **None** – if the alarm is to be indicated (default factory setting)
- **Both** – alarm is indicated by an Alarm mode relay and output current
- **Current** – alarm is indicated by the output current only
- **Relay** – alarm is indicated by an Alarm mode relay only

For information on Alarm mode relays, see "Set-up the relays" on page 69.

Parameter **P402** is used to decide how the output current indicates an alarm condition. See "Set-up the current output" on page 68 for alarm action options.

P540 PV Over Limits (Factory default is "None")

- Select the indication method for the alarm condition that happens while the control unit PV value is outside pre-set limits. See also "PV Limits mode relay" on page 83

P541 mA Out Sat (Factory default is "None")

- Select the indication method for the alarm condition that happens while the output current is ≤ 3.8 mA or ≥ 20.5 mA

P542 Log mem filling (Factory default is "None")

- Select the indication method for the alarm condition that happens while the available logging memory is low. See also "**P593** Low Mem Alarm (Default is 0%)" on page 64

P543 Digital Input (Factory default is **"**None**"**)

- Select the indication method for the alarm condition that happens while a digital input, configured with an action to force this alarm, is energized.
- See "Digital inputs IN1 and IN2" on page 63 for how to select the **Alarm** action required for this feature

P544 Max retries (Factory default is **"**None**"**)

- Select the indication method for the alarm condition that happens while a Custom relay operation is unable to complete, even after a pre-set number of attempts (**P257**)
- See also "Custom mode relay" on page 86 for information

P545 mA In Sat (Factory default is "None")

- Select the indication method for the alarm condition that happens while the output current is saturated i.e. ≤ 3.7 mA or ≥ 20.75 mA

P547 Rising Level (Factory default is "None")

- Select the indication method for the Rising Level alarm condition
- See "Rising Level alarm" on page 89 for information

P548 RL Operations (Factory default is "None")

- Select the indication method for the alarm condition that happens while a relay operation counter is higher than a pre-set limit
- See "Relay Operations alarm" on page 88 for information

P549 RL runtime (Factory default is "None")

- Select the indication method for the alarm condition that happens while a relay is energized for longer than a pre-set period
- See "Relay Run-time alarm" on page 88 for information

P550 Pump efficiency (Factory default is "None")

- Available on the Mobrey MCU901 and MCU902 control units only
- Select the indication method for the alarm condition that happens while the calculated pump efficiency falls below a pre-set limit
- See "Pump Efficiency alarm (Mobrey MCU901 and MCU902 only)" on page 89 for information

P551 No activity (Factory default is "None")

- Select the indication method for the alarm condition that happens while any selected relay is de-energized for longer than a pre-set period
- See "No Activity alarm" on page 88 for information

Table 4-8. Reporting of alarms and faults on the control unit

Category	Source	Cause	As seen on screen	Status LED	Full PV Display	Relay Output	Current Output	Alarm Report (D830)	Fault Report (D831)
ALARM	MCU900	Current Output reached linear limit	mA o/p Sat			Yes	Yes	Yes	
		Logging memory almost full	Lg Mem Filling			Yes	Yes	Yes	
		Logging memory is full	Log Mem Full				Yes	Yes	
		Digital Input 1 active	Digital In 1			Yes	Yes	Yes	
		Digital Input 2 active	Digital In 2			Yes	Yes	Yes	
		Alarm suppressed by digital input	Alarm Suppressed					Yes	
		Custom relay operation retries exceeded	Max Retries			Yes	Yes	Yes	
		Current input below lower linear limit	mA In Low			Yes	Yes	Yes	
		Current input above higher linear limit	mA In High			Yes	Yes	Yes	
		Raising level despite relays on	Rising Level			Yes	Yes	Yes	
		Relay number of operations exceeded	Relay Operations			Yes	Yes	Yes	
		Relay run-time exceeded	Relay Runtime			Yes	Yes	Yes	
		Pump efficiency below limit (1)	Pump Efficiency			Yes	Yes	Yes	
		No activity of Control Relay	No activity			Yes	Yes	Yes	
	XMTR	Transmitter PV out-of-limits	PV OL				Yes	Yes	
FAULT	MCU900	Rom checksum error	ROM Error	Constant	Yes	Yes	Yes		Yes
		RAM test error	RAM Error	Constant	Yes	Yes	Yes		Yes
		Real Time Clock Fault	Clock fault	Constant	Yes	Yes	Yes		Yes
		EEPROM Signature Error	EEPROM Sig err	Constant	Yes	Yes	Yes		Yes
		EEPROM checksum error	EEPROM CKS err	Constant	Yes	Yes	Yes		Yes
		ADC error	ADC_error	Constant	Yes	Yes	Yes		Yes
		Control Unit temperature out-of-limits	CU Temp OL	Constant		Yes	Yes		Yes
	Xmtr	Field Device Malfunction	Xmtr Fault	Constant	Yes	Yes	Yes		Yes

(1) The pump efficiency feature is on Mobrey MCU901 and MCU902 control units.

4.5.23 Set-up totalizing on the Mobrey MCU901 control unit

Totalizer (cumulative totalized flow) on the Mobrey MCU901

The MCU901 has an internal 8-digit totalizer that is updated several times every second.

Note

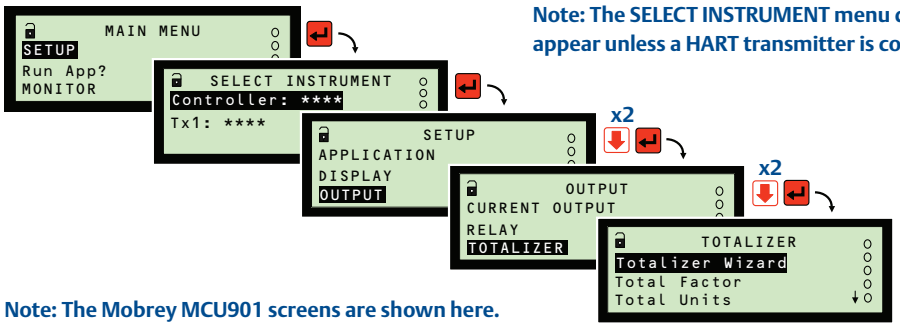
- The totalizer operates with an input of the control unit PV (**D800**) in units per second. When the PV is a volumetric flow rate (e.g. m^3/hour), the totalizer can accumulate this flow volume and give the total volume throughput

The totalizer can be easily set-up using the Totalizer Wizard, accessible by navigating to the TOTALIZER menu. The Totalizer Wizard also forms a part of the Application (App) Wizard. See "Using the App Wizard to set-up a flow application" on page 41 for a totalizing example. After using the Totalizer or App Wizard, adjustments can be made to the totalizer parameters.

Note

- The wizard requires the totalizer source parameter to have suitable units selected e.g. m^3/hour. If no suitable units are selected, an 'invalid units' message appears.

Figure 4-43. Navigating to the TOTALIZER menu



Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

P530 Total Factor (Factor default is 0.0)

- One count is added to the Totalizer Count (**D828**) for a quantity of liquid as defined by this parameter. The display units for **D828** is defined by **P531**.

P531 Total Units (Factory default is **"**None**"**)

- This parameter defines the units for the Totalizer Count (D828).

  When using totalizer units of **`gal`**, an 8-digit totalizer increments rapidly and rolls over too frequently. To help, alternative totalizer units of **`galx10`**, **`galx100`**, **`galx1000`**, and **`Mgal`** are available for selection. When these special units are selected *after* selecting **`gal`** units, the totalizer factor (**P530**) is automatically re-scaled by x10, x100, x1000, or x1000000 depending on the selection. Similarly, re-scaling is automatic for **`ltrx10`**, **`ltrx100`**, etc. *after* selecting **`ltr`** as totalizer units.

  See "Using the App Wizard to set-up a flow application" on page 41 for a flow application example where **`galx100`** totalizer units are needed.

P534 Pulse Width (Factory default is **"**100 ms**"**)

- A Totalizer mode relay is energized for a programmed duration (**P534**) each time the Totalizer Count (**D828**) is incremented. Parameter **P534** controls the pulse width (i.e. the pulse 'on' time) and is between 10 ms and 2.5 s, changeable in steps of 10 ms. See "Set-up the relays" on page 69 for information on Totalizer mode relays
- Parameter **P534** also defines the pulse width for a Sampler mode relay (see "Set-up the relays" on page 69)

Menu: MONITOR / [CONTROLLER /] READINGS / TOTALIZER

D828 Totalizer

- This parameter displays the Totalizer Count. To add this to the Full PV Display, see "Display configuration options" on page 102.

How to reset the totalizer on the Mobrey MCU901

Menu: MONITOR / [CONTROLLER /] READINGS / TOTALIZER

To re-set a totalizer to zero, display the Totalizer Count parameter **D828** and then press the button corresponding to **Reset** command on display line 4.

The totalizer may have password (PIN) protection to prevent unauthorized persons from re-setting the total. See "PIN Security" on page 105 for full details of PIN security.

4.5.24 Set-up totalizing on the Mobrey MCU902 control unit

The Mobrey MCU902 has two independent, internal 8-digit totalizers, **Totalizer 1** and **Totalizer 2,** which are updated several times every second.

The totalizers can be easily set-up using the Totalizer Wizard, accessible by navigating to the SETUP / [CONTROLLER /] OUTPUT / TOTALIZER menu. The Totalizer Wizard also forms a part of the Application (App) Wizard.

Note

- The wizards require the totalizer source parameter to have suitable units selected e.g. m^3/hour. If no suitable units are selected, an 'invalid units' message appears.
- See "Using the App Wizard to set-up a flow application" on page 41 for a totalizing example. After using the Totalizer or App Wizard, adjustments can be made to the totalizer parameters.

Set-up Totalizer 1

Note

- The totalizer operates with an input of control unit PV (**D800**) in units per second. If the PV is a volumetric flow rate (e.g. m^3/hour), the totalizer can accumulate this flow volume and give the total volume throughput

Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

P530 Total 1 factor (Factor default is 0.0)

- One count is added to the Totalizer count (**D828**) for a quantity of flow as defined by this parameter. The unit of measurement for **D828** is defined by parameter **P531**

P531 Total 1 units (Factory default is **"**None**"**)

- This parameter defines the units for the Totalizer 1 Count (**D828**).

  When using totalizer units of **`gal`**, an 8-digit totalizer increments rapidly and rolls over too frequently. To help, alternative totalizer units of **`galx10`**, **`galx100`**, **`galx1000`**, and **`Mgal`** are available for selection. When these special units are selected *after* selecting **`gal`** units, the totalizer factor (**P530**) is automatically re-scaled by x10, x100, x1000, or x1000000 depending on the selection. Similarly, re-scaling is automatic for **`ltrx10`**, **`ltrx100`**, etc. *after* selecting **`ltr`** as totalizer units.

  See "Using the App Wizard to set-up a flow application" on page 41 for a flow application example where **`galx100`** totalizer units are needed.

P534 Pulse Width (Factory default is **"**100ms**"**)

- A Totalizer mode relay is energized for a programmed duration (**P534**) each time the Totalizer count (**D828** or **D829**) is incremented. **P534** controls the pulse width (i.e. the pulse 'on' time) and is between 10 ms and 2.5 s, changeable in steps of 10 ms
- Parameter **P534** also defines the pulse width for a Sampler mode relay (see "Set-up the relays" on page 69)

Menu: MONITOR / [CONTROLLER /] READINGS / TOTALIZER

D828 Totalizer 1

- This read-only parameter displays the Totalizer 1 Count. To add this to the Full PV Display, see "Display configuration options" on page 102.

Note

- A Totalizer mode relay can be configured to output a pulse for each increment (by one) to the Totalizer 1 Count parameter. See "Set-up the relays" on page 69 for information on Totalizer mode relays

Set-up Totalizer 2

Totalizer 2 operates in the same way as Totalizer 1, but counts the parameter selected by **P536**. Parameter **P536** offers a choice of control unit PV, SV, TV, and FV.

Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

P532 Total 2 factor (Factor default is 0.0)

- One count is added to the Totalizer 2 Count (**D829**) for a quantity of liquid as defined by this parameter. The units for D829 is defined by P533.

P533 Total 2 units (Factory default is "None")

- This parameter defines the units for the Totalizer 2 Count (**D829**).

  When using totalizer units of **`gal`**, an 8-digit totalizer increments rapidly and rolls over too frequently. To help, alternative totalizer units of **`galx10`**, **`galx100`**, **`galx1000`**, and **`Mgal`** are available for selection. When these special units are selected *after* selecting **`gal`** units, the totalizer factor (**P532**) is automatically re-scaled by x10, x100, x1000, or x1000000 depending on the selection. Similarly, re-scaling is automatic for **`ltrx10`**, **`ltrx100`**, etc. *after* selecting **`ltr`** as totalizer units.

  See "Using the App Wizard to set-up a flow application" on page 41 for a flow application example where **`galx100`** totalizer units are needed.

P534 Pulse Width (Factory default is **"**100ms**"**)

- A Totalizer mode relay is energized for a programmed duration (**P534**) each time the Totalizer count (**D828** or **D829**) is incremented. **P534** controls the pulse width (i.e. the pulse 'on' time) and is between 10 ms and 2.5 s, changeable in steps of 10 ms
- Parameter **P534** also defines the pulse width for a Sampler mode relay (see "Set-up the relays" on page 69)

P536 Totalizer 2 Source (Factory default is "None")

- If requiring Totalizer 2, select a parameter to be totalized

Menu: MONITOR / [CONTROLLER /] READINGS / TOTALIZER

D829 Totalizer 2

- This read-only parameter displays the Totalizer 2 Count. To add this to the Full PV Display, see "Display configuration options" on page 102.

How to reset the totalizers on the Mobrey MCU902

To re-set a totalizer to zero, display the Totalizer Count parameter e.g. **D828** and then press the button corresponding to **Reset** command on display line 4.

The totalizers may have password (PIN) protection to prevent unauthorized persons from re-setting the totals. See "PIN Security" on page 105 for full details of PIN security.

4.5.25 Set-up totalizing on the Mobrey MCU90F control unit

The Mobrey MCU90F control unit has two totalizers: **Totalizer 1** and **Totalizer 2**.

The totalizers can be easily set-up using the Totalizer Wizard, accessible by navigating to the SETUP / [CONTROLLER /] OUTPUT / TOTALIZER menu. The Totalizer Wizard also forms a part of the Application (App) Wizard.

Note

- The wizards require the totalizer source parameter to have suitable units selected e.g. m^3/hour. If no suitable units are selected, an 'invalid units' message appears.

See "Using the App Wizard to set-up a flow application" on page 41 for a totalizing example. After using the Totalizer or App Wizard, adjustments can be made to the totalizer parameters.

Set-up Totalizer 1 (cumulative totalized flow)

This is an 8-digit totalizer showing cumulative totalized flow through a flow structure.

Note

- Totalizer 1 operates with an input of control unit PV (**D800**) in units per second. If the PV is a volumetric flow rate (e.g. m^3/hour), the totalizer can accumulate this flow volume and give the total volume throughput. See "Pumped volume totalizing" on page 90 for pumped volume totalizing

Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

P530 Total 1 Factor (Factor default is 0.0)

- One count is added to the Totalizer Count (**D828**) for a quantity of liquid as defined by this parameter. The display units for **D828** is defined by **P531**.

P531 Total 1 Units (Factory default is "None")

- This parameter defines the units for the Totalizer Count (**D828**).

  When using totalizer units of **`gal`**, an 8-digit totalizer increments rapidly and rolls over too frequently. To help, alternative totalizer units of **`galx10`**, **`galx100`**, **`galx1000`**, and **`Mgal`** are available for selection. When these special units are selected *after* selecting **`gal`** units, the totalizer factor (**P530**) is automatically re-scaled by x10, x100, x1000, or x1000000 depending on the selection. Similarly, re-scaling is automatic for **`ltrx10`**, **`ltrx100`**, etc. *after* selecting **`ltr`** as totalizer units.

  See "Using the App Wizard to set-up a flow application" on page 41 for a flow application example where **`galx100`** totalizer units are needed.

P534 Pulse Width (Factory default is **"**100ms**"**)

- A Totalizer mode relay is energized for a programmed duration (**P534**) each time the Totalizer count (**D828 / D829**) is incremented. **P534** controls the pulse width (i.e. the pulse 'on' time) and is between 10 ms and 2.5 s, changeable in steps of 10 ms
- Parameter **P534** also defines the pulse width for a Sampler mode relay (see "Set-up the relays" on page 69)

Note

- See "Set-up the relays" on page 69 for information on Totalizer mode relays

Menu: MONITOR / [CONTROLLER /] READINGS / TOTALIZER

D828 Totalizer 1

- This read-only parameter displays the Totalizer 1 count, which is the cumulative totalized flow. To add this to the Full PV Display, see "Display configuration options" on page 102

Set-up Totalizer 2 (daily totalized flow)

This is an 8-digit totalizer showing daily total flow (midnight to midnight) through a flow structure. It is automatically re-set to zero at each midnight.

Note

- A relay on the control unit can be configured to output a pulse for each increment to the Totalizer Count parameter. See "Set-up the relays" on page 69 for how to do this

Menu: SETUP / [CONTROLLER /] OUTPUT / TOTALIZER

P532 Total 2 Factor (Factor default is 0.0)

- One count is added to the Totalizer 2 Count (**D829**) for a quantity of liquid as defined by this parameter. The display unit of measurement for **D829** is defined by **P533**

P533 Total 2 Units (Factory default is "None")

- This parameter defines the units for the Totalizer 2 Count (**D829**).

P534 Pulse Width (Factory default is **"**100 ms**"**)

- A Totalizer mode relay is energized for a programmed duration (**P534**) each time the Totalizer Count (**D828** or **D829**) is incremented. **P534** controls the pulse width (i.e. the pulse 'on' time) and is between 10 ms and 2.5 s, changeable in steps of 10 ms
- Parameter **P534** also defines the pulse width for a Sampler mode relay (see "Set-up the relays" on page 69)

Note

- See "Set-up the relays" on page 69 for information on Totalizer mode relays

P536 Total 2 Source (Factory default is **"**MCU PV**"**)

- Use this to select whether the control unit PV (D800), SV (D801), TV (D802) or FV (D803) value is to be totalized over a 24 hours period for the Totalizer 2 Count (**D829**). Alternatively, select **None** if not requiring Totalizer 2.

See "Optional change: transmitter input channel settings (advanced users)" on page 43 for details of PV, SV, TV, and FV

P537 Total 2 dec pl (Factory default is 1)

- Use this to set the number of decimal places to be shown when displaying the Totalizer 2 Count (**D829**)

Menu: MONITOR / [CONTROLLER /] READINGS / TOTALIZER

D829 Totalizer 2

- This read-only parameter displays the Totalizer 2 count, which is the **daily flow total** for the present day. It is reset to zero at midnight.

  To add this value to the PV display, see "Display configuration options" on page 102. When showing on the upper display line, use the **LEFT-ARROW** or **RIGHT-ARROW** buttons to scroll through daily flow totals from the previous 365 days. The **Esc** button restores the upper display line to show the daily flow total value for the present day

How to reset the totalizers on the Mobrey MCU90F

To reset a totalizer to zero, display the Totalizer Count parameter e.g. **D828** and then press the button that corresponds to **Reset** command on display line 4.

Totalizers may have password (PIN) protection to prevent unauthorized persons from re-setting the totals. See "PIN Security" on page 105 for full details of PIN security.

4.5.26 Display configuration options

The factory default configuration of the full display can be changed to show different graphic and text information.

Menu: SETUP / [CONTROLLER /] OUTPUT / DISPLAY

P570 Display Upper (Factory default is "P731-Time")

- Select from the multiple-choice list of parameters (see Table 4-9 on page 103). For example, a totalizer count can be displayed when **D828-Totalizer** is selected. If it will fit, the clock time will also be displayed alongside the selected parameter

P571 Display Middle (Factory default is "D800-PV")

- Select from the multiple-choice list of parameters (see Table 4-9 on page 103). For example, the control unit Secondary Value (SV) value can be displayed when **D801-SV** is selected

P572 Display Lower (Factory default is **"**Bar graph**"**)

- Select from the multiple-choice list of parameters (see Table 4-9 on page 103). For example, you can display a user-defined message (P241) when the 'P241' option is selected

P573 Decimal places (Factory default is 3)

- Use this to adjust the number of decimal places. Range 0 to 5. Alternatively, select "Disabled" (Auto) for the control unit to automatically choose the number of decimal places for a displayed parameter value

P574 Display size (Factory default is "Large")

- Use this to adjust whether the display shows the **Large PV Display** after a period of keypad inactivity, or remains showing the **Full PV Display**.

P575 Back light (Factory default is "On")

- Select from **On** (always on), **Off** (always off) or **Auto** (goes on when using keypad; goes off after 5 minutes of inactivity)

Table 4-9. Full PV Display options

P570/1/2 Options	Parameters
None	(Nothing selected)
D800-PV	Control unit Primary / Process Variable (PV)
D801-SV	Control unit SV value
D802-TV	Control unit TV value
D803-FV	Control unit FV value
D805-%mA Out	Percentage of Current Output (4–20 mA span)
D806-mA Output	Actual output current
D809-RoC	Rate of Change of control unit PV
D828-Totalizer	Totalizer value (for the MCU901)
D828-Totalizer 1	Totalizer 1 value (for the MCU902 and MCU90F)
D829-Totalizer 2	Totalizer 2 value (for the MCU902 and MCU90F)
D821-RL1 RTime	Running time for relay RL1, if energized
D822-RL2 RTime	Running time for relay RL2, if energized
D823-RL3 RTime	Running time for relay RL3, if energized
D824-RL4 RTime	Running time for relay RL4, if energized
D825-RL5 RTime	Running time for relay RL5, if energized
D840-mA Input	Actual current input
D844-Internal C	Temperature inside of the control unit
D846	Logging memory remaining
D900-PV In	Transmitter PV (Primary Variable)
D901-SV In	Transmitter SV (Secondary Variable)
D902-TV In	Transmitter TV (Tertiary Variable)
D903-FV In	Transmitter FV (Fourth Variable)
P240-Descript (1)	Free-form description
P241-Message (1)	Free-form message
P242-Tag (1)	Free-form tag name
P730-Date	Date
P731-Time	Time of day
Bar graph	Bar graph for Current Output (for lower display only)

(1) Parameter is in menu: SETUP / [CONTROLLER /] APPLICATION

4.5.27 Serial communications

This section is applicable if the RS232 serial port of a communication device (e.g. a PC) is connected:

- directly to the RS232 terminals of the MCU901 or MCU902 control unit or
- indirectly via factory-fitted data download socket of the MCU90F control unit

Note

- See “RS232 connections” on page 22 for connections details.

Menu: SETUP / [CONTROLLER /] SYSTEM / COMMUNICATIONS

P710 Address (Factory default is 0)

- Keep the factory default setting.

P711 Interface

- Choose between **Log download** (Mobrey MCU90F), **RS232 HART**, or None.

P712 Baud Rate (Factory default is 1200 or 9600)

- This must be the same as set for the RS232 serial port of the communication device. Range is 1200 to 115200.

P713 Start Bits (Factory default is 1)

- This must be the same as set for the RS232 serial port of the communication device. Range is 0 to 9.

P714 Data Bits (Factory default is 8)

- This must be the same as set for the RS232 serial port of the communication device. Range is 0 to 9.

P715 Parity (Factory default is **“**Even**”**)

- This must be the same as set for the RS232 serial port of the communication device. Options are **Even**, **Odd** or **None**.

P716 Stop Bits (Factory default is 1)

- This must be the same as set for the RS232 serial port of the communication device. Range is 0 to 9

4.5.28 PIN Security

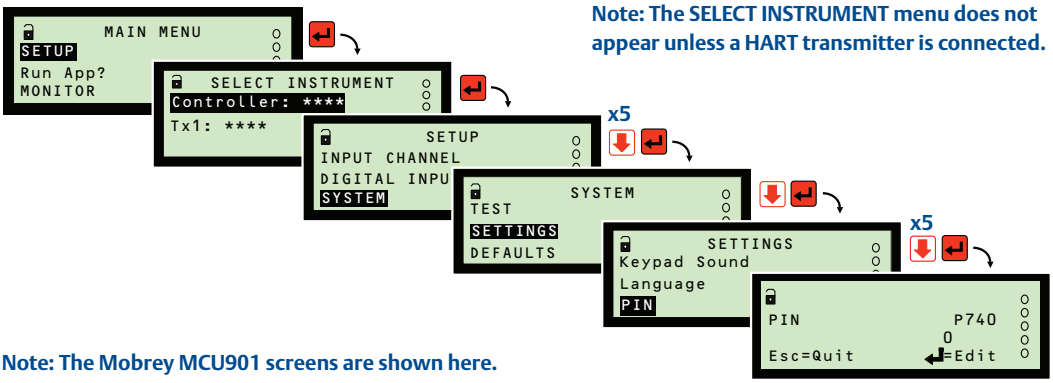
Personal Identification Number (PIN) security prevents unauthorized people from configuring the control unit. Typically, this is set-up when all the other programming has been completed. As with bankcards, there is one PIN number.

The factory default is for PIN security to be inactive. To activate, navigate the menu system to the PIN screen and edit a 4-digit personal identification number (PIN) that you want. The PIN is edited with the arrow keys and confirmed with the red (ENTER) button; the 4-digit PIN will then be replaced by "- - - -" to indicate that PIN security is active. (By default, the PIN is "0" if inactive).

After PIN security is activated, a prompt for the PIN appears when needed for authorization. If correctly entered, no further PIN requests are made unless there is a period of keypad inactivity, or the Cancel Password option is selected from the MAIN MENU screen.

If the PIN number has been forgotten, contact Rosemount Measurement for assistance. Please ensure that you have the serial number of the control unit available.
It is located in the menu system at: SETUP / [CONTROLLER /] SYSTEM / FIXED / Serial No.

Figure 4-44. Navigating to the PIN set-up screen



Section 5 Servicing and Health Checking

5.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

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⚠ WARNING

Failure to follow these installation guidelines could result in death or serious injury:

- The Mobrey MCU900 Series control unit must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment

Explosions could result in death or serious injury:

- Please review the approvals section of this reference manual for any restrictions associated with an installation

Electrical shock could cause death or serious injury:

- If the control unit is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the control unit is off while making connections

5.2 Servicing the MCU900 Series control unit

Before servicing, **disconnect the power**.

No maintenance is required beyond occasional cleaning of the enclosure with a damp cloth. Solvents or bleaches should not be used.

Do not modify or repair the unit. There are no spare parts for the Mobrey MCU900 Series control unit. If a problem persists, contact Rosemount Measurement for advice.

5.2.1 Replacing the fuse on mains ac-powered control units

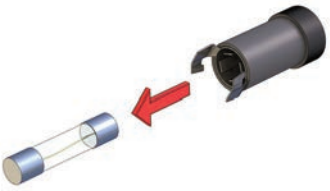
Before starting, **disconnect the power**. Follow the procedure in Figure 5-1 (wall-mount units) or Figure 5-2 (panel-mount unit). See "Electrical" on page 117 for the fuse type.

Figure 5-1. How to replace the fuse on a mains-powered wall-mount control units

Carefully turn the flat-bladed screwdriver anti-clockwise, until the fuse-holder is released.

Lift the fuse-holder upwards and away from the control unit.

Pull the old fuse out from the fuse-holder.



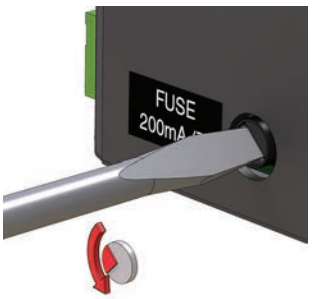
Push the new fuse into the fuse-holder.

Carefully place the fuse-holder back, noting the vertical position of the notch.

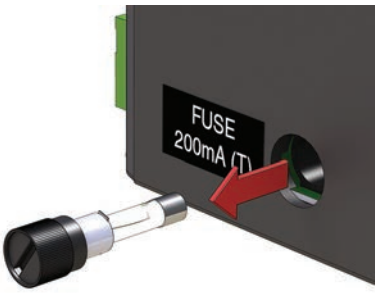
Push the fuse-holder downwards, and then twist clock-wise until the fuse-holder stays in position.

Figure 5-2. How to replace the fuse on a mains-powered panel-mount control unit

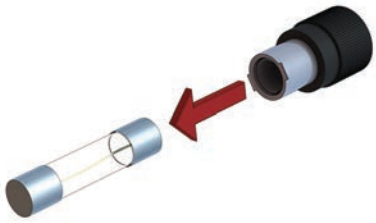
Carefully turn the flat-bladed screwdriver anti-clockwise, until the fuse-holder is released.



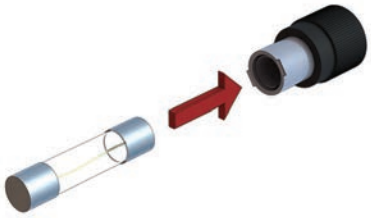
Lift the fuse-holder away from the control unit.



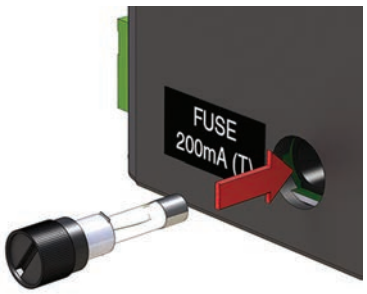
Pull the old fuse out from the fuse-holder.



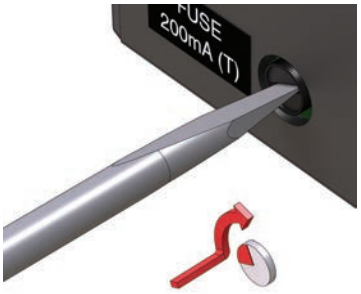
Push the new fuse into the fuse-holder.



Carefully place the fuse-holder back, noting the angled position of the notch.



Push the fuse-holder inwards, and then twist clock-wise until the fuse-holder stays in position.



5.3 Health checking the MCU900 Series control unit

This section is a guide to the health check system, which includes tests, calibrations, live readings, and diagnostic data for the MCU900 Series control unit.

5.3.1 Simulation (self-test)

Menu:
SETUP / [CONTROLLER /] APPLICATION / SIMULATION

The Simulation (or Self-Test) function is selected by pressing the **red (ENTER)** button at the SIMULATION screen.

To start, press the **UP-ARROW** button once.

When started, the **control unit Primary/Process Value (PV)** is driven up to a maximum value (**P401**) and then driven down to a minimum value (**P400**), continuously, therefore exercising the Current Output and relays. It always begins at the 4 mA point.

A single cycle takes approximately 100 seconds to complete.

To pause at any time, press the **UP-ARROW** button. When paused, pressing the **UP-ARROW** button once will resume the cycle. You can also press the **DOWN-ARROW** to pause, and press it again to change direction of the cycle.

To quit at any time, even when paused, press the **Esc** button once to exit immediately to the Full PV Display. The PV value calculation then immediately resumes being based on the transmitter inputs.

5.3.2 Display test

Menu:
SETUP / [CONTROLLER /] SYSTEM / TEST / DISPLAY

The Display Test function is started by pressing the **red (ENTER)** button at the DISPLAY screen.

When the test is started, a pre-defined pattern sequence exercises all the LCD pixels. After several seconds, the test ends by displaying the model code and software version number.

To re-run the Display Test, press the **red (ENTER)** button again. Otherwise, press the **Esc** button to exit to the menu.

5.3.3 Calibration of the Current Input (I_{in})

Menu:
SETUP / [CONTROLLER /] SYSTEM / TEST / CURRENT INPUT

Procedure for 4 mA input calibration

1. Apply 4 mA to the Current Input (I_{in}) terminal.

   (See "Electrical installation" on page 13 for terminal layouts and connection diagrams).

2. Select the **4 mA In Adjust** menu option.

3. Press the **red (ENTER)** button once.

Procedure for 20 mA input calibration

1. Apply 20 mA to the Current Input (I_{in}) terminal.

   (See "Electrical installation" on page 13 for terminal layouts and connection diagrams).

2. Select the **20 mA In Adjust** menu option.

3. Press the **red (ENTER)** button once.

5.3.4 Fixing the Current Output (I_{out})

Menu:
SETUP / [CONTROLLER /] SYSTEM / TEST / CURRENT OUTPUT

Procedure for temporarily fixing the Current Output

1. Select the **Set Current** menu option.

2. Edit a mA value in the range 4–20 mA.

3. Save the mA value to then fix the output current from the Current Output (I_{out}) terminal at that level.

   (See "Electrical installation" on page 13 for terminal layouts and connection diagrams).

Pressing the **Esc** button will exit to the menu and restore the output current to the level corresponding to the control unit Primary/Process Value (**D800**).

5.3.5 Calibration of the Current Output (I_{out})

Menu:
SETUP / [CONTROLLER /] SYSTEM / TEST / CURRENT OUTPUT

Procedure for 4 mA output calibration

1. Select the **4 mA Out Adjust** menu option.
2. Measure the output current from the Current Output (I_{out}) terminal.

   (See "Electrical installation" on page 13 for terminal layouts and connection diagrams).
3. If the measured current is not 4 mA, edit the existing value to be the actual mA reading and then save it.

Procedure for 20 mA output calibration

1. Select the **20 mA Out Adjust** menu option.
2. Measure the output current from the Current Output (I_{out}) terminal.

   (See "Electrical installation" on page 13 for terminal layouts and connection diagrams).
3. If the measured current is not 20 mA, edit the existing value to be the actual mA reading and then save it.

5.3.6 Monitoring the control unit readings

Menu: MONITOR / [CONTROLLER /] READINGS

Answers

D800 PV ANSWERS / PV

- This is the live control unit Primary/Process Value (PV) that is described in the section "Optional change: transmitter input channel settings (advanced users)" on page 43.

D801 SV ANSWERS / SV

- This is the live control unit Secondary Value (SV) that is described in the section "Optional change: transmitter input channel settings (advanced users)" on page 43.

D802 TV ANSWERS / TV

- This is the live control unit Third/Tertiary Value (TV) value that is described in "Optional change: transmitter input channel settings (advanced users)" on page 43.

D803 FV ANSWERS / FV

- This is the live control unit Fourth Value (FV) that is described in the section "Optional change: transmitter input channel settings (advanced users)" on page 43.

D804 Ullage

- This indicates how much a vessel or open-channel falls short of being full. It is calculated as the difference between the upper range value (URV) of the Current Output and the control unit PV i.e. **D804** = (**P401 - D800**)

D805 % Current Output ANSWERS / % Current Out

- This indicates the present amount of electrical current being output from the 4–20 mA Current Output as a percentage.

Note

- The output current is while the control unit is in the **Program** operating mode.

D806 Current O/P ANSWERS / Current Output

- This indicates the present amount of electrical current being output from the 4–20 mA Current Output as a mA value.

Rate of change

D809 Rate of Change Rate of Change

- This indicates the calculated rate of change of the control unit PV.
  See also "Rate of Change mode relay" on page 83 for how to use parameter **D809** values.

Relay

D811 RL1 Ops RELAY / RELAY OPERATIONS

- This indicates the number of operations carried out by relay **RL1**. It can be re-set to zero by pressing the **red (ENTER)** button when displaying **D811**.

  The operation count is used by the Relay Operations Alarm feature
  (see "Relay Operations alarm" on page 88).

D812 to **D815** are the operation counters for other relays.

D820 Relay Status RELAY / Relay Status

- This indicates a series of 0 and 1 digits which represent the de-energized (0) or energized (1) relays.

  The first digit represents Relay **RL1**, the second digit represents Relay **RL2**, etc.

D821 RL1 Run-Time RELAY / RELAY RUN TIME

- This indicates the total time that relay **RL1** has been energized for the present relay operation. It is cumulative i.e. does not reset when the relay RL1 is de-energized.

  The run-time is used by the Relay Run Time Alarm feature.
  (see "Relay Operations alarm" on page 88).

D822 to **D825** are the running times for the other relays.

Totalizer (Mobrey MCU901 only)

D828 Totalizer Totalizer

- This indicates the totalizer count.

  See "Set-up totalizing on the Mobrey MCU901 control unit" on page 95 for details of the totalizing feature on the MCU901.

Totalizer (Mobrey MCU902 and MCU90F only)

D828 Totalizer 1 Totalizer

- This indicates the Totalizer 1 count.

  See "Set-up totalizing on the Mobrey MCU902 control unit" on page 97 for details of the totalizing feature on the MCU902.

  See "Set-up totalizing on the Mobrey MCU90F control unit" on page 99 for details of the totalizing feature on the MCU90F.

D829 Totalizer 2 Totalizer

- This displays the Totalizer 2 count.

  See "Set-up totalizing on the Mobrey MCU902 control unit" on page 97 for details of the totalizing feature on the MCU902.

  See "Set-up totalizing on the Mobrey MCU90F control unit" on page 99 for details of the totalizing feature on the MCU90F.

Alarm report

D830 Alarm Report

- This is for viewing live alarms.

  The highest priority alarm is listed first. Use the **UP/DOWN-ARROW** buttons to scroll through the list if more than one alarm exists. If there are no live alarms, the alarm report indicates "none".

  See Table 4-8 on page 94 for a summary of other alarm reporting features.

Fault report

D831 Fault Report

- This is for viewing live faults.

  The highest priority fault is listed first. Use the **UP/DOWN-ARROW** buttons to scroll through the list if more than one fault exists. If there are no live faults, the fault report indicates "none".

  See Table 4-8 on page 94 for a summary of other fault reporting features.

5.3.7 Diagnostic data for the MCU900 Series control unit

Menu: MONITOR / [CONTROLLER /] DIAGNOSTICS

I/P status (input status)

D835 I/P Status

- This indicates a series of 0 and 1 digits which represent the inactive (0) and active (1) digital trigger inputs.

  The first digit represents digital trigger input **IN1**, and the second digit represents digital trigger input **IN2**.

Current i/p (current input)

D840 Current I/P

- This indicates the present electrical input current in mA.

  See the section "Optional change: transmitter input channel settings (advanced users)" on page 43 for how this parameter is used.

mA input

D842 mA Input %

- This indicates the present electrical input current as a percentage of the 4–20 mA range.

  See "Optional change: transmitter input channel settings (advanced users)" on page 43 for how this parameter is used.

CU temperature

D844 CU Temperature

- This indicates the present operating temperature within the MCU900 Series control unit.
  If above 65 °C, it is a fault condition (see "Fault mode relay" on page 82).

Next pump down

D845 Next Pump down

- This indicates the time remaining before the next pump-down is started.

  See "Pump-down (Mobrey MCU901 and MCU902 only)" on page 85 for feature details.

Free memory (Mobrey MCU90F only)

D846 Free Memory

- This indicates the percentage of free memory remaining for the data logging feature.

  See "**P593** Low Mem Alarm (Default is 0%)" on page 64 for the Low Memory Alarm feature details.

Date of change

D848 Date of Change

- This indicates the date on which a parameter was last edited.

1st pwr date

D849 1st Pwr Date

- This indicates the date on which the control unit was first powered-up.

Transmitter channels

D851 Ch1 Output

- This indicates the result from Transmitter Input Channel 1.

  See "Optional change: transmitter input channel settings (advanced users)" on page 43 for how this value is calculated.

D852 Ch2 Output

- This indicates the result from Transmitter Input Channel 2.

  See "Optional change: transmitter input channel settings (advanced users)" on page 43 for how this value is calculated.

Pump efficiency

D861 Pump effy RL1

- This shows the pump efficiency percentage for relay RL1.
  See also "Pump Efficiency alarm (Mobrey MCU901 and MCU902 only)" on page 89.

D862 to **D864** indicate the pump efficiencies for the relays **RL2**, **RL3**, and **RL4**. Note that this pump efficiency calculation is not available for relay **RL5**.

5.3.8 Model code, serial number, and software and hardware revisions

The factory-set values of the following parameters may be requested from you if you ever contact Rosemount Measurement. for help with this product. They can't be edited.

Menu: SETUP / [CONTROLLER /] SYSTEM / FIXED

D750 Model Code

- This is the full model number of your MCU900 Series control unit.

D751 Serial No (serial number)

- This is the unique serial number of the MCU900 Series control unit.

D752 H/W Revision

- This is the revision number of the particular build of your MCU900 Series control unit.

D753 S/W Revision

- This is the revision number of the software release that is running on the MCU900 Series control unit.

Appendix A Reference Data

A.1 Specifications

A.1.1 General

Product

- MCU900 Series Universal Control Units:
  MCU901 Standard Control Unit
  MCU902 Differential Control Unit
  MCU90F Logging Control Unit

Mounting styles

- Wall or panel mount

Power options

- AC mains or DC

A.1.2 Display

Type

- Dot matrix LCD, 32 x 122 pixels, back lit

Location

- Integrated into enclosure

Indicators

- Red LED for health status

A.1.3 Electrical

AC mains power supply input

- 115 or 230 Vac ±10% (switch selectable)
- Power consumption: 10 VA nominal, 18 VA maximum
- Fuse: 200 mA(T), 5 x 20 mm, 250 V

DC power supply input

- 15 to 30 Vdc, 30 Vdc maximum
- Power consumption: 9 W maximum

Current input

- 4–20mA (Earth referenced in control unit) or
  HART digital communications (revisions 5, 6, and 7)
- Supplies 23 volts from 400 Ohm source resistance

Trigger inputs

- 2 voltage-free contact closures

Relays

- 5 x SPDT, 5 A at 240 Vac

Current output

- Signal range (nominal): 4–20 mA
- Output range (linear):
- 3.8 to 20.5 mA (user-selectable alarm current of 3.6 mA or 21 mA
- Load: Rmax is 1 K Ohm
- Resolution: 12-bit
- Regulation: < 0.1% over load change from 0 to 600 Ohms
- Isolation: Isolated from other terminals to 500 Vdc
- Update rate (software): 5 times per second

Cable entry

- Wall mount enclosure:

  5 positions pre-drilled, 2 cable glands and 3 blanking plugs supplied
- Panel enclosure:

  Direct wiring to terminal blocks at rear

Cable connection

- Wall mount enclosure:

  Cage clamp terminal blocks in separate terminal compartment
- Panel mount enclosure:

  2-part cage clamp terminal blocks at rear

A.1.4 Mechanical

Materials of construction (wall mount)

- Polycarbonate enclosure and cover
- 304SST cover fixing screws
- UV resistant Polycarbonate membrane keypad
- Nylon cable glands and blanking plugs

Materials of construction (panel mount)

- Noryl PPO enclosure and cover
- Carbon Steel / Zinc plated fascia fixing screws
- UV resistant Noryl PPO membrane keypad
- Nylon + PBT terminal blocks with plated fittings

Dimensions

- See Dimensional drawings on pages 121 to 122

Weight

- Wall mount:
  1.4 kg (mains unit) or 1.0 kg (DC unit)
- Panel mount:
  1.2 kg (mains unit) or 0.8 kg (DC unit)

A.1.5 Environment

Ambient temperature

- –40 to 55 °C (–40 to 131 °F)

  See Appendix B: Product Certifications for approval temperatures ranges

Relative humidity

- Wall mount: 100%
- Panel mount: 90% non-condensing

Electrical safety

- EN61010-1

Ingress protection

- Wall mount: IP65 indoor/outdoor
- Panel mount: IP40 indoor mount (or IP65 if with optional hood)

Vibration

- Control Room: 0.1 to 9 Hz 1.5 mm displacement peak amplitude / 9 to 200 Hz 0.5 g

Installation category

- Category III: Supply voltage < 127Vac (IEC60664)
- Category II: Supply voltage < 254Vac (IEC60664)

Pollution degree

- 2 (IEC60664)

Maximum altitude

- 2000 m

Electromagnetic compatibility

- Emissions and immunity for IP-rated wall mount and panel mount: EN61326-1:2006

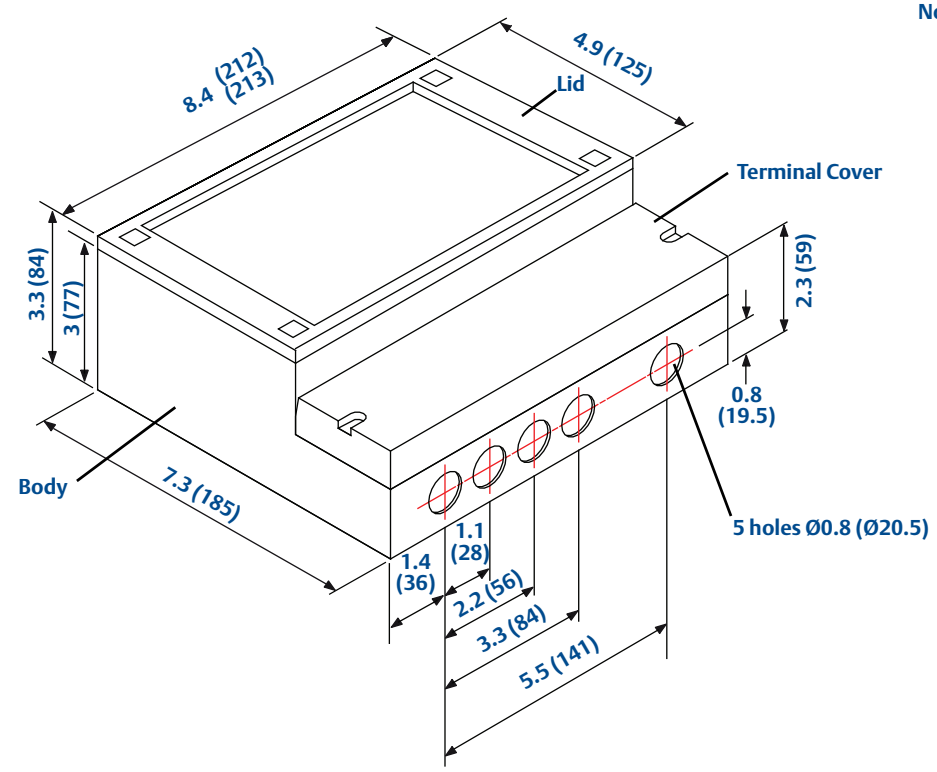
Certifications

- CE-mark, ATEX, and IECEx

A.2 Dimensional drawings

Figure A-1. Dimensions for the wall-mounted unit

Note: Dimensions are in inches (mm)



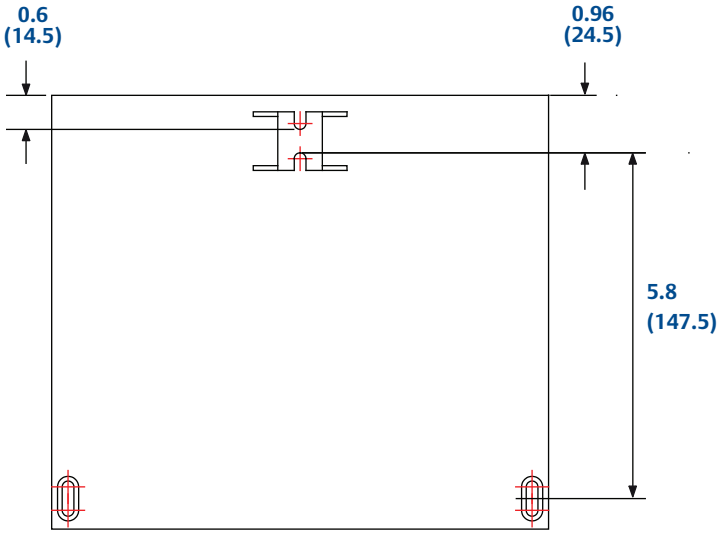
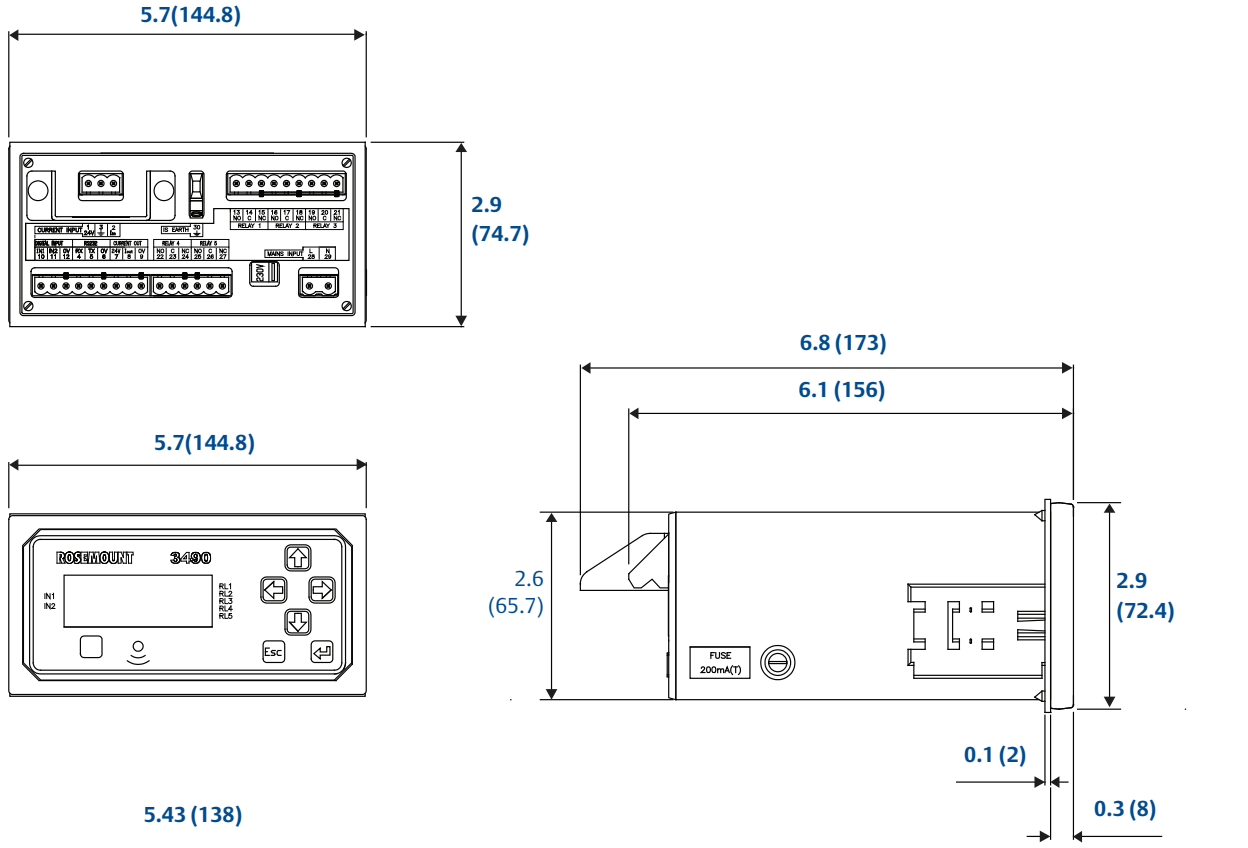


Figure A-2. Dimensions for the panel-mounted unit

Note: Dimensions are in inches (mm)



For safety, the panel should be strong enough to support the 1.2 kg (mains power) or 0.8 kg (DC power) mass of the unit.

Appendix B Product Certifications

B.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

Explosions could result in death or serious injury:

- Verify that the operating environment of the MCU900 Series control unit is consistent with the appropriate hazardous locations certifications

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure the MCU900 Series control unit is installed by qualified personnel and in accordance with applicable code of practice
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
- Do not perform any service other than those contained in this manual unless you are qualified

High voltage that may be present on leads could cause electrical shock:

- Avoid contact with leads and terminals
- Make sure the main power to the MCU900 Series control unit is off

B.2 European directive information

The EC declaration of conformity for all applicable European directives for this product can be found in the Mobrey MCU900 Series safety manual (IP2030/SI) on the Mobrey brand pages at www.emersonprocess.com.

ATEX directive (94/9/EC)

- Emerson Process Management complies with the ATEX directive

Low voltage directive (2006/95/EC)

- The Mobrey MCU900 Series control unit complies with EN61010 Part 1

Pressure equipment directive (PED) (97/23/EC)

- The Mobrey MCU900 Series control unit is outside the scope of PED

Electro magnetic compatibility (EMC) directive (2004/108/EC)

- The Mobrey MCU900 Series control unit complies with EN61326-1: 2006

Restriction of hazardous substances (RoHS)

- The Mobrey MCU900 Series control unit is exempt

B.3 Hazardous locations certifications

Note

- The MCU900 Series is mounted in a non-hazardous area, and provides a protected (intrinsically safe) 24 volts direct current supply to a transmitter in a hazardous area.
- See also the Mobrey MCU900 Series safety manual (document number IP2030/SI) for ATEX and IECEx conditions for safe use.

B.3.1 ATEX intrinsically safe approval

Certificate numbers: BAS00ATEX7064 (Wall Mount), BAS01ATEX7225X (Panel Mount)
Intrinsically safe for II (1) GD, [Ex ia] IIC, [Ex ia Da] IIIC
Ambient temperature: –40 °C to +55 °C
Uo = +28 V, Io = 120 mA, Po = 0.82 W, Li = 0.2 mH, Ci = 0.6 nF

Special conditions for safe use (certificate BAS01ATEX7225X)

- Terminal 30 must be earthed in the safe area to a high integrity earth/ground point in a non-hazardous area.

B.3.2 IECEx intrinsically safe approval

Certificate Number: IECEx SIR 06.0090X
Intrinsically safe for [Ex ia] IIC, [Ex ia Da] IIIC
Ambient temperature: –40 °C to +55 °C
Uo = +27.3 V, Io = 96.9 mA, Po = 0.66 W, Li = 0.2 mH, Ci = 0.6 nF

Special conditions for safe use

- Terminal 30 must be earthed in the safe area to a high integrity earth/ground point in a non-hazardous area.

Appendix C Menus and Parameters

C.1 Menus and parameters

This chapter contains the full menu system maps for:

- Mobrey MCU900 Series control units – see Table C-1 on page 126
- Generic HART 4, 6, and 7 transmitters – see Table C-2 on page 132

Note

- If a Mobrey MSP Series transmitter is connected, refer to the reference manual on the Mobrey brand pages at www.emersonprocess.com for full information about programming the transmitter parameters (e.g. Transmitter Bottom Reference) using the MCU900 Series control unit or other HART-based devices.

Table C-1. Mobrey MCU900 Series control unit

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Param Num.	Parameter Name	Units	Factory Defaults	Min	Max	Reference Pages
Cancel password				-	Cancel password	-	-	-	-	105
SETUP (1)	APPLICATION	App Wizard		-	App Wizard	-	-	-	-	39
		SIMULATION			Simulation	-	-	-	-	110
		Description		P240	Description	-	(Factory set)	-	-	103
		Message		P241	Message		MESSAGE	-	-	103
		Tag		P242	Tag		(Factory set)	-	-	103
	DISPLAY	Display Upper		P570	Display Upper		P731-Time	-	-	102
		Display Middle		P571	Display Middle		D800-PV	-	-	102
		Display Lower		P572	Display Lower		Bar graph	-	-	102
		Decimal places		P573	Decimal places		3			102
		PV Units		P200	PV Units	-	%	-	-	44
		SV Units		P201	SV Units	-	None	-	-	44
		TV Units		P202	TV Units	-	%	-	-	44
		FV Units		P203	FV Units	-	None	-	-	44
		Display size		P574	Display size	-	Large	-	-	102
		Backlight		P575	Backlight	-	On	-	-	102
	OUTPUT	CURRENT OUTPUT	Low Range Val	P400	Low Range Val	as P200	0	-	-	68
			Up Range Val	P401	Up Range Val	as P200	100	-	-	68
			Alarm Action	P402	Alarm Action	-	3.6 mA	-	-	68
			mA Source	P405	mA Source	-	MCU PV			68
		RELAY	Relay Wizard	-	Relay Wizard	-	0	-	-	69
			Reset RL Params		Reset RL Params	-	-	-	-	70
			RELAY 1	P410	Relay 1 Mode	-	Free	-	-	70
				P411	Relay 1 On Point	As P200	0	-	-	70
				P412	Relay 1 Off Point	As P200	0	-	-	70
				P413	Relay 1 Minimum On Time	mmm:ss	000:00	-	-	70
				P414	Relay 1 Maximum On Time	mmm:ss	000:00	-	-	70
				P415	Relay 1 Minimum Off Time	mmm:ss	000:00	-	-	70
			RELAY 2	P420	Relay 2 Mode	-	None	-	-	70
				P421	Relay 2 ON Point	As P200	0	-	-	70
				P422	Relay 2 OFF Point	As P200	0	-	-	70
				P423	Relay 2 Minimum On Time	mmm:ss	000:00	-	-	70
				P424	Relay 2 Maximum On Time	mmm:ss	000:00	-	-	70
				P425	Relay 2 Minimum Off Time	mmm:ss	000:00	-	-	70
			RELAY 3	P430	Relay 3 Mode	-	None	-	-	70
				P431	Relay 3 ON Point	As P200	0	-	-	70
				P432	Relay 3 OFF Point	As P200	0	-	-	70
				P433	Relay 3 Minimum On Time	mmm:ss	000:00	-	-	70
				P434	Relay 3 Maximum On Time	mmm:ss	000:00	-	-	70
				P435	Relay 3 Minimum Off Time	mmm:ss	000:00	-	-	70

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Param Num.	Parameter Name	Units	Factory Defaults	Min	Max	Reference Pages
(SETUP)	(OUTPUT)	(RELAY)	RELAY 4	P440	Relay 4 Mode	-	None	-	-	70
				P441	Relay 4 ON Point	As P200	0	-	-	70
				P442	Relay 4 OFF Point	As P200	0	-	-	70
				P443	Relay 4 Minimum On Time	mmm:ss	000:00	-	-	70
				P444	Relay 4 Maximum On Time	mmm:ss	000:00	-	-	70
				P445	Relay 4 Minimum Off Time	mmm:ss	000:00	-	-	70
			RELAY 5	P450	Relay 5 Mode	-	None	-	-	70
				P451	Relay 5 ON Point	As P200	0	-	-	70
				P452	Relay 5 OFF Point	As P200	0	-	-	70
				P453	Relay 5 Minimum On Time	mmm:ss	000:00	-	-	70
				P454	Relay 5 Maximum On Time	mmm:ss	000:00	-	-	70
				P455	Relay 5 Minimum Off Time	mmm:ss	000:00	-	-	70
			ALARM	P490	Rising level alarm delay	mmm:ss	000:00	-	-	89
				P491	Relay operations alarm limit	-	0	-	-	88
				P492	Relay operations relay select	-	Disabled	-	-	88
				P493	Relay runtime alarm limit	hh:mm	00:00	-	-	88
				P494	Relay runtime relay select	-	Disabled	-	-	89
				P495 (2)	Pump efficiency limit	-	0	-	-	89
				P496 (2)	Pump efficiency relay select	-	0	-	-	89
				P497	No activity delay	hh:mm	00:00	-	-	88
				P498	No activity relay	hh:mm	00:00	-	-	88
			OVERRIDES	P499	Pump On Delay	s	3	0	9	84
				P270 (3)	Auto Sequence Enable	-	Off	-	-	84
				P271 (3)	Auto Sequence Qualifier	-	0	-	-	84
				P272 (3)	Pump-down Relay	-	0	-	-	86
				P273 (3)	Pump-down Interval	hh.mm	00:00	-	-	86
				P274 (3)	Pump-down Duration	hh.mm	00:00	-	-	86
				P275	Energy Saving Start Time	hh.mm	00:00	-	-	85
				P276	Energy Saving Relay Select	-	0	-	-	85
				P277 (3)	Scum Line Prevention variance	-	0	-	-	85
				P278 (3)	Scum Line Prevention relay	-	0	-	-	85
			CUSTOM	P250	Start On	-	None	0	4	86
				P251	Stop On	-	None	0	3	86
				P252	Stop If	-	None	0	253	86
				P253	Start Time	hh.mm	07:00	-	-	86
				P254	Interval	hh.mm	01:00	-	-	86
				P255	Start Time #2	hh.mm	00:00	-	-	86
				P256	Interval #2	hh:mm	00:00	-	-	86
				P257	Max Retries	-	10	0	250	86, 91

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Param Num.	Parameter Name	Units	Factory Defaults	Min	Max	Reference Pages
(SETUP)	(OUTPUT)	TOTALIZER [4]	Totalizer Wizard		Totalizer Wizard	-	0	-	-	95, 97, 99
			Total [1] Factor	P530	Totalizer [1] Factor	-	0	0	-	95, 97, 99
			Total [1] Units	P531	Totalizer [1] Units	-	0	0	-	95, 97, 99
			Total 2 Factor	P532	Totalizer 2 Factor	-	0	0	-	97
			Total 2 Units	P533	Totalizer 2 Units	-	0	0	-	97
			Total 2 Source	P536	Totalizer 2 Source	-	0	-	-	97
			Pulse Width	P534	Pulse Width	ms	100	10	2500	95, 97, 99
			Sample Factor	P535	Sampler Factor	-	0	0	-	95, 97, 99
			Total 2 dec pl	P537 [5]	Total 2 decimal places	-	1	-	-	97
		PV DAMPING	MCU PV Damping	P210	MCU PV Damping	s	0	-	-	44
		ALARM	PV over Limits	P540	PV Over Limits	-	None	-	-	91
			mA Out Sat	P541	Current Output Saturated	-	None	-	-	91
			Memory Filling	P542	Memory Filling [6]	-	None	-	-	91
			Digital Input	P543	Digital Input	-	None	-	-	91
			Max Retries	P544	Maximum number of retries	-	None	-	-	91
			mA In Sat	P545	Current Input Saturated	-	None	-	-	91
			Rising Level	P547	Rising Level	-	None	-	-	91
			RELAY	P548	Relay operations	-	None	-	-	91
				P549	Relay runtime	-	None	-	-	91
				P550	Pump efficiency	-	None	-	-	91
				P551	No activity	-	None	-	-	91
		FAULT	System Fault	P560	System Fault	-	Both	-	-	82
			CU Temp Fault	P561	Control Unit Temperature Fault	-	None	-	-	82
			Xmtr Fault	P562	Transmitter Fault	-	Both	-	-	82
			Digital Input	P563	Digital Input	-	None	-	-	82
	LOGGING [6]				Logging Wizard	-	0	-	-	66
				P590	Logging Interval	min	0	0	99	64
				P591	Fast logging select mode	as P200	0 (=Off)	0	-	64
				P592	Do/Do not overwrite old data	-	On	-	-	64
				P593	Low memory alarm threshold	%	0	0	99	64
	INPUT CHANNEL (MCU901/MCU 90F)	Ch1 I/P Source		P111	Ch1 I/P Source		Tx1 : PV	-	-	44, 48
		Ch1 I/P Offset		P112	Channel 1 Input Offset	-	0	-	-	44, 48
		Ch1 Profile		P113	Channel 1 Profile	-	Scaled	-	-	44, 48
		Ch1 Pre Scale		P114	Channel 1 Input Scale Factor	-	1	-	-	44, 48
		Ch1 NLP Data		P115	Channel 1 Non-Linear Data	-	0	-	-	44, 48
		Ch1 Post Scale		P116	Channel 1 Post Scale	-	1	-	-	44, 48
		Ch1 Low Cut-off		P117	Channel 1 Low Cut-off	as P201	None	-	-	44, 48
		Cur I/P Damping		P321	Current Input 1 Damping	sec	5	0	99.9	44, 48

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Param Num.	Parameter Name	Units	Factory Defaults	Min	Max	Reference Pages
(SETUP)	PV CALCULATION (MCU902)	CHANNEL 1	Ch1 I/P Source	P111	Channel 1 Input Source		Tx1 : PV	-	-	44, 48
			Ch1 I/P Offset	P112	Channel 1 Input Offset	-	0	-	-	44, 48
			Ch1 Profile	P113	Channel 1 Profile	-	Scaled	-	-	44, 48
			Ch1 Pre Scale	P114	Channel 1 Input Scale Factor	-	1	-	-	44, 48
			Ch1 NLP Data	P115	Channel 1 Non-Linear Data	-	0	-	-	44, 48
			Ch1 Post Scale	P116	Channel 1 Post Scale	-	1	-	-	44, 48
			Ch1 Low Cut-off	P117	Channel 1 Low Cut-off	as P201	None	-	-	44, 48
		CHANNEL 2	Ch2 I/P Source	P121	Channel 2 Input Source		Tx2 : PV	-	-	50
			Ch2 I/P Offset	P122	Channel 2 Input Offset	-	0	-	-	50
			Ch2 Profile	P123	Channel 2 Profile	-	Scaled	-	-	50
			Ch2 Pre Scale	P124	Channel 2 Input Scale Factor	-	1	-	-	50
			Ch2 NLP Data	P125	Channel 2 Non-Linear Data	-	0	-	-	50
			Ch2 Post Scale	P126	Channel 2 Post Scale	-	1	-	-	50
			Ch2 Low Cut-off	P127	Channel 2 Low Cut-off	as P202	None	-	-	50
		Output Mapping		P150	Output Mapping	-	Ch1	-	-	50
		MCU FV Source		P151	MCU Fourth Variable Source	-	Tx1: FV	-	-	50
		Cur I/P Damping		P321	Current Input 1 Damping	sec	5	0	99.9	44, 48
	DIGITAL INPUT	DIGITAL INPUT 1	Dig In1 Action	P340	Digital Input 1 Action	-	Free	-	-	61
			Dig In1 Delay	P341	Digital Input 1 Delay	mmm.ss	000:00	-	-	61
			Dig In1 Active	P342	Digital Input 1 Active	-	Closed	-	-	61
		DIGITAL INPUT 2	Dig In2 Action	P345	Digital Input 2 Action	-	Free	-	-	61
			Dig In2 Delay	P346	Digital Input 2 Delay	mmm:ss	000:00	-	-	61
			Dig In2 Active	P347	Digital Input 2 Active	-	Closed	-	-	61
	SYSTEM	TEST	DISPLAY		Display Test	-	-	-	-	110
			CURRENT INPUT		4mA input adjust	-	-	-	-	111
					20mA input adjust	-	-	-	-	111
			CURRENT OUTPUT	P700	4mA output adjust	-	-	-	-	112
				P701	20mA output adjust	-	-	-	-	112
				P702	Set Current	mA	0	-	-	111
		SETTINGS	Date	P730	Date	-	(Factory set)	-	-	42
			Time	P731	Time	-	-	-	-	42
			Date Format	P734	Date format	-	dd/mm/yy	-	-	42
			Keypad Sound	P735	Keypad sound on/off	-	Off	-	-	42
			Language	P737	Language	-	English	-	-	42
			PIN	P740	PIN	-	0			105
		DEFAULTS		-	LOAD FACTORY DEFAULTS	-	-	-	-	135
		Transmitter Wizard		-	Transmitter Wizard	-	-	-	-	

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Param Num.	Parameter Name	Units	Factory Defaults	Min	Max	Reference Pages
(SETUP)	(SYSTEM)	COMMUNICATIONS	Address	P710	Comms address of control unit	-	0	0	15	104
			Interface	P711	Interface type	-	See (7)	-	-	104
			Baud Rate	P712	Baud rate	-	See (8)	-	-	104
			Start Bits	P713	Number of start bits	-	1	1	2	104
			Data Bits	P714	Number of data bits	-	8	7	8	104
			Parity	P715	Parity of data	-	Odd	-	-	104
			Stop Bits	P716	Number of stop bits	-	1	1	2	104
		FIXED	Model Code	D750	Model code	-	(Factory set)	-	-	116
			Serial No	D751	Serial Number - Control Unit	-	(Factory set)	-	-	116
			H/W Revision	D752	Hardware Revision	-	(Factory set)	-	-	116
			S/W Revision	D753	Software Version	-	(Factory set)	-	-	116
			HART	D760	Manufacturer's Code	-	(Factory set)	-	-	116
				D761	Unique ID	-	(Factory set)	-	-	-
				D762	Universal command revision	-	5	-	-	-
				D763	Txr spec. command revision	-	2	-	-	-
				D764	Pre-amble bytes	-	5	-	-	-
				D765	Flags	-	1	-	-	-
Run App? / Program?				-	Run App? / Program?	-	-	-	-	38
MONITOR (1)	READINGS	ANSWERS	PV	D800	Primary / Process Variable	As P200	-	-	-	43 - 50, 112
			SV	D801	Secondary Variable	As P201	-	-	-	43 - 50, 112
			TV	D802	Tertiary Variable	As P202	-	-	-	43 - 50, 112
			FV	D803	Fourth Variable	As P203	-	-	-	43 - 50, 112
			Ullage	D804	Ullage	As P200	-	-	-	112
			% Current Out	D805	% Current Output	%	-	-	-	112
			Current O/P	D806	Current Output	mA	-	-	-	112
		Rate of Change		D809	Rate of PV change	PV/min	-	-	-	83, 90, 113
		RELAY	RELAY OPERATIONS	D811	Relay 1 Operations Counter	-	0	-	-	88, 113
				D812	Relay 2 Operations Counter	-	0	-	-	88, 113
				D813	Relay 3 Operations Counter	-	0	-	-	88, 113
				D814	Relay 4 Operations Counter	-	0	-	-	88, 113
				D815	Relay 5 Operations Counter	-	0	-	-	88, 113
			Relay Status	D820	Relay Status	-	-	-	-	113
			RELAY RUN TIME	D821	Relay 1 run-time	hh:mm	-	-	-	88, 113
				D822	Relay 2 run-time	hh:mm	-	-	-	88, 113
				D823	Relay 3 run-time	hh:mm	-	-	-	88, 113
				D824	Relay 4 run-time	hh:mm	-	-	-	88, 113
				D825	Relay 5 run-time	hh:mm	-	-	-	88, 113
		Totalizer		D828	Totalizer 1 value (4)	As P531	-	0	-	95, 114
				D829	Totalizer 2 value (4)	As P533	-	0	-	95, 114
		Alarm Report		D830	Alarm Report	-	None	-	-	91, 114
		Fault Report		D831	Fault Report	-	None	-	-	82, 114

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Param Num.	Parameter Name	Units	Factory Defaults	Min	Max	Reference Pages
(MONITOR)	DIAGNOSTICS	I/P Status		D835	Digital Input status	-	-	-	-	61, 115
		Current I/P		D840	Current Input	mA	-	-	-	43, 115
		mA Input %		D842	Current Input %	%	-	-	-	43, 115
		CU Temperature		D844	Temperature of Control Unit	°C	-	-	-	82, 115
		Next Pump down		D845	Time to next pump-down	hh:mm	-	-	-	85, 115
		Free memory		D846	Logging memory free (6)	%	-	-	-	64, 115
		Date of Change		D848	Date of last change	ddmmyy	--/--/--	-	-	115
		1st Pwr Date		D849	Data of 1st power-on	ddmmyy	--/--/--	-	-	116
		CHANNELS (9)	Ch1 Output	D851	Channel 1 Output	As P201	-	-	-	44, 48, 116
			Ch2 Output	D852	Channel 2 Output	As P202	-	-	-	50,116
		PUMP EFFICIENCY (2) (10)	Pump effy RL1	D861	Pump efficiency RL1	%	-	-	-	89, 116
			Pump effy RL2	D862	Pump efficiency RL2	%	-	-	-	89, 116
			Pump effy RL3	D863	Pump efficiency RL3	%	-	-	-	89, 116
			Pump effy RL4	D864	Pump efficiency RL4	%	-	-	-	89, 116
ADVANCED	Pxx			-	-	-	-	-	-	136
	Dxx			-	-	-	-	-	-	136

(1) Selecting SETUP menu presents a SELECT INSTRUMENT screen if a HART transmitter is assigned to a Current Input channel. Select CONTROL UNIT tag to see Menu Level 2 options.

(2) The pump efficiency calculation is available on the Mobrey MCU901 and MCU902 - see "Pump Efficiency alarm (Mobrey MCU901 and MCU902 only)" on page 89.

(3) Relay override features are available on the Mobrey MCU901 and MCU902 - see "Set-up the relays" on page 69.

(4) There is one totalizer on the Mobrey MCU901. There are two totalizers on the Mobrey MCU902 and MCU90F.

(5) The "Totalizer 2" display option is available on the Mobrey MCU90F only - see "Set-up totalizing on the Mobrey MCU90F control unit" on page 99.

(6) Data logging is available on the Mobrey MCU90F only - see "Data logging on the Mobrey MCU90F" on page 64.

(7) Factory default is "Log download" on the Mobrey MCU90F and is "RS232 HART" on the Mobrey MCU901 and MCU902.

(8) Factory default is "1200" for the Mobrey MCU90F, and "9600" for the Mobrey MCU901 and MCU902.

(9) The second channel output is on the Mobrey MCU902 only.

(10) Relay 5 does not support the pump efficiency calculation.

Table C-2. Generic HART 5, 6, and 7 transmitters

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Menu Level 5	Param Num.	Parameter Name	HART 5	HART 6	HART 7
SETUP	DUTY	IDENTITY	Message		P000	Message	Yes	Yes	Yes
			Tag		P001	Tag	Yes	Yes	Yes
			Descriptor		P002	Descriptor	Yes	Yes	Yes
			Long Tag		P091	Long Tag[1]	–	Yes	Yes
		SET PV ZERO			–	SET PV ZERO	–	Yes	Yes
		Transfer Function			P019	Transfer Function	–	Yes	Yes
		UNITS			P012	PV Units	Yes	Yes	Yes
		OUTPUT	VARIABLE ASSIGNMENT	PV Assignment	P006	PV Assignment	–	Yes	Yes
				SV Assignment	P007	SV Assignment	–	Yes	Yes
				TV Assignment	P008	TV Assignment	–	Yes	Yes
				QV Assignment	P009	QV Assignment	–	Yes	Yes
			CURRENT	Upper Range Value	P015	Upper Range Value	Yes	Yes	Yes
				Lower Range Value	P016	Lower Range Value	Yes	Yes	Yes
				Loop Current Active	P017	Loop Current Active	–	Yes	Yes
				Damping	P020	Damping	Yes	Yes	Yes
				Range Value Units	–	Range Value Units	–	Yes	Yes
		SYSTEM	TRIM	Fix Current Output	–	Fix Current Output	Yes	Yes	Yes
				Trim 4 mA	–	Trim 4 mA	Yes	Yes	Yes
				Trim 20 mA	–	Trim 20 mA	Yes	Yes	Yes
			TEST	Simulate PV	P098	Simulate PV	–	Yes	Yes
				Locate Dev	P099	Locate Device (Squawk)	–	Yes	Yes
			DATE/TIME	Present Date	P051	Present Date	–	–	Yes
				Present Time	P052	Present Time	–	–	Yes
			RESET	RESTART	–	RESTART	–	Yes	Yes
				MASTER R.	–	MASTER R.	Yes	Yes	Yes
				FLUSH DR	–	FLUSH DR	–	Yes	Yes
			BURST	CANCEL BURST 0	–	CANCEL BURST 0	–	Yes	Yes
				CANCEL BURST 1	–	CANCEL BURST 1	–	–	Yes
				CANCEL BURST 2	–	CANCEL BURST 2	–	–	Yes
			SECURITY	Write Protect Code	D978	Write Protect Code	–	Yes	Yes
				Lock Status	D979	Lock Status	–	Yes	Yes
				UNLOCK DEVICE	–	UNLOCK DEVICE	–	Yes	Yes
			FIXED	Final Assy Number	P004	Final Assy Number	Yes	Yes	Yes
				Xducer Serial Numbr	P005	Xducer Serial Number	Yes	Yes	Yes
				Hardware Revision	D952	Hardware Revision	Yes	Yes	Yes
				HART	D950	HART Device Type	–	Yes	Yes
					D951	Poll Address	Yes	Yes	Yes
					D953	Software Revision	Yes	Yes	Yes
					D960	Manufacturer	–	Yes	Yes
					D961	Device ID	Yes	Yes	Yes

MAIN MENU	Menu Level 2	Menu Level 3	Menu Level 4	Menu Level 5	Param Num.	Parameter Name	HART 5	HART 6	HART 7
(SETUP)	(DUTY)	(SYSTEM)	(FIXED)	(HART)	D962	HART Revision	Yes	Yes	Yes
					D963	Device Revision	Yes	Yes	Yes
					D964	Request Preambles	–	Yes	Yes
					D966	Response Preambles	–	Yes	Yes
					D967	Max Number of Dev Variables	–	Yes	Yes
MONITOR	READINGS	VARIABLES	Primary Variable		D900	Primary Variable	Yes	Yes	Yes
			Secondary Variable		D901	Secondary Variable	Yes	Yes	Yes
			Tertiary Variable		D902	Tertiary Variable	Yes	Yes	Yes
			Quaternery Variable		D903	Quaternery Variable	Yes	Yes	Yes
		CURRENT	Current Output		D906	Current Output	Yes	Yes	Yes
			% Current Output		D905	% Current Output	Yes	Yes	Yes
	DIAGNOSTICS	HISTORY	Date		P003	Date	Yes	Yes	Yes
			Conf. Change Counter		P968	Conf. Change Counter	–	Yes	Yes
		STATUS	DEV SPEC 1	Field Device Status	D981	Field Device Status	–	Yes	Yes
				Additional Status 0	D982	Additional Status 0	–	Yes	Yes
				Additional Status 1	D983	Additional Status 1	–	Yes	Yes
				Additional Status 2	D984	Additional Status 2	–	Yes	Yes
				Additional Status 3	D985	Additional Status 3	–	Yes	Yes
				Additional Status 4	D986	Additional Status 4	–	Yes	Yes
				Additional Status 5	D987	Additional Status 5	–	Yes	Yes
			STANDARD	Extended Dev Status	D988	Extended Dev Status	–	Yes	Yes
				Device Op Mode	D989	Device Op Mode	–	Yes	Yes
				Standard Status 0	D990	Standard Status 0	–	Yes	Yes
				Standard Status 1	D991	Standard Status 1	–	Yes	Yes
				Analog Chan Sat.	D992	Analog Chan Sat.	–	Yes	Yes
				Standard Status 2	D993	Standard Status 2	–	Yes	Yes
				Standard Status 3	D994	Standard Status 3	–	Yes	Yes
				Analog Chan Fixed	D995	Analog Chan Fixed	–	Yes	Yes
			DEV SPEC 2	Additional Stat 14	D996	Additional Stat 14	–	Yes	Yes
				Additional Stat 15	D997	Additional Stat 15	–	Yes	Yes
				Additional Stat 16	D998	Additional Stat 16	–	Yes	Yes
				Additional Stat 17	D999	Additional Stat 17	–	Yes	Yes
		TRANSDUCER	Upper Xducer Limit		D941	Upper Xducer Limit	–	Yes	Yes
			Lower Xducer Limit		D942	Lower Xducer Limit	–	Yes	Yes
			Xducer Min Span		D943	Xducer Min Span	–	Yes	Yes
		COMMS STATS	STX Count		D969	STX Count	–	–	Yes
			ACK Count		D970	ACK Count	–	–	Yes

(1) The control unit LCD supports the viewing and editing of up to 16 characters.

Appendix D Additional Features

D.1 Restoring the factory defaults

D.1.1 How to restore the factory default settings

Note

- The factory defaults may not be the same as the settings when shipped from the factory. It is advisable to keep a record of settings, if possible.

Procedure to restore the control unit to the factory defaults, erasing all user-entered data

1. If there are HART transmitters connected:
   a. Navigate to SETUP / [CONTROLLER /] SYSTEM / Transmitter Wizard
   b. Start the Wizard, and use the **Remove** option for *each connected transmitter*.

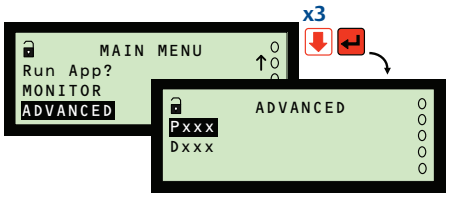
   This removal action clears the control unit memory of all transmitter data that has been uploaded from a HART transmitter, including the Transmitter Bottom Reference.
2. Navigate to the SETUP / [CONTROLLER /] SYSTEM / DEFAULTS menu (see Figure 8).
3. Press the **red (ENTER)** button *twice* and then wait until “Done”.
4. Switch off
5. If there are two transmitters connected to a Mobrey MCU902 control unit:
   a. Switch-off power to the MCU900 Series control unit.
   b. Remove the second transmitter that is associated with Transmitter Input Channel 2.
   c. Switch-on power to the MCU900 Series control unit
6. Put the control unit into **Run App** mode (to automatically find a HART transmitter)
7. If the control unit is a Mobrey MCU902 control unit:
   a. Switch-off power to the MCU900 Series control unit.
   b. Re-connect the second transmitter.
   c. Switch-on power to the MCU900 Series control unit
8. Turn back to Section 4: Getting started, to start again.

D.2 ADVANCED parameter access

The ADVANCED parameter access is selected from the MAIN MENU (see Figure D-1).

It provides a quick and direct access to parameter screens without traversing the menu system. All that is required is the entry of the unique 3-digit identification (ID) number for a parameter. Appendix C: Menus and Parameters has a list of all parameters and their identification numbers.

Figure D-1. Navigating to the ADVANCED menu



Both 'P' and 'D' prefixed parameters can be accessed through separate selection screens. After entering the ADVANCED menu, select **Pxxx** or **Dxxx** (see Figure D-2).

Next, input a valid identification number using the arrow buttons (**010** is the default) and press the **red (ENTER)** button to confirm and make that parameter screen appear (see Figure D-3). When an input parameter number is not valid, the nearest valid parameter is displayed instead (see Figure D-4 on page 137).

Pressing the **Esc** button allows a new number to be input to access another parameter. This is very convenient when checking on more than one parameter.

Figure D-2. Pxxx or Dxxx selection

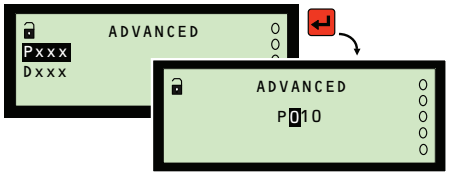


Figure D-3. Pxxx editing example with valid parameter number

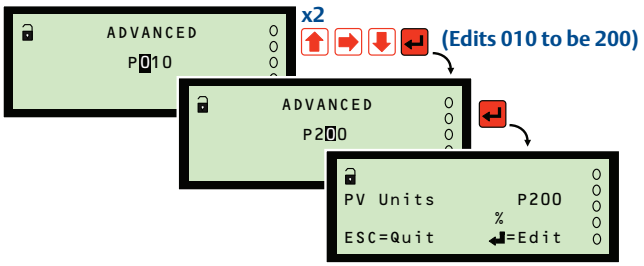
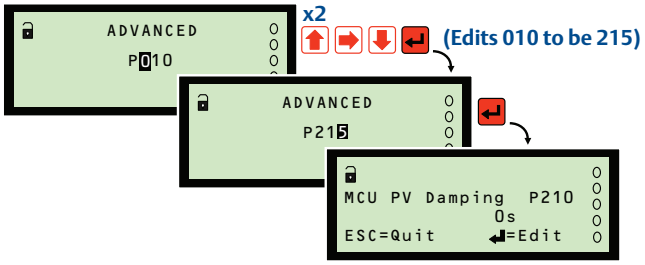
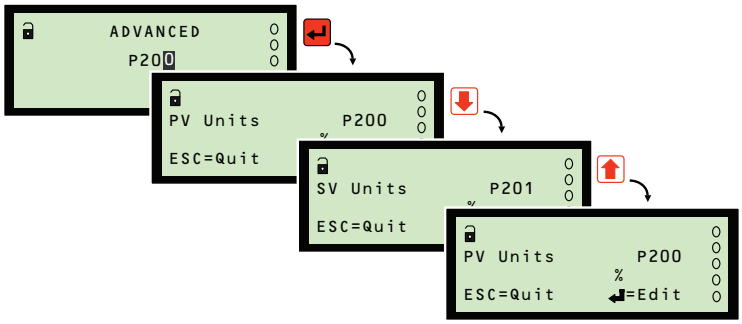


Figure D-4. Pxxx editing with no valid parameter number



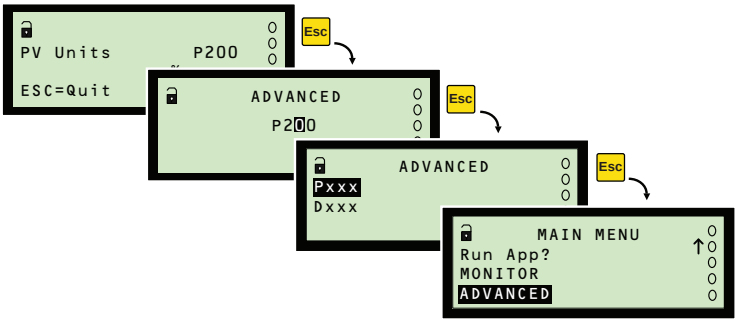
While displaying a parameter, after using this direct feature, the **UP-ARROW** or **DOWN-ARROW** buttons can scroll through adjacent parameters (see Figure D-5).

Figure D-5. How to scroll through adjacent parameters



Use the **Esc** button to return to the **Pxxx** or **Dxxx** selection screen. To exit to the **MAIN MENU**, press the **Esc** button repeatedly (see Figure D-6).

Figure D-6. How to return to the menu system



Appendix E Support for HART® Transmitters

E.1 Overview

The Mobrey MCU900 Series control unit is able to accept digital data from any HART 5/6/7 compatible transmitter. However, the control unit is not Device Descriptor (DD) based and only fully supports transmitters that have been factory programmed into the on-board library.

E.2 Fully supported HART transmitters

Fully supported HART transmitters, where all parameters of the transmitter are accessible for reading and writing by the MCU900 Series control unit:

- Mobrey MSP400RH level transmitter (HART 5)
- Mobrey MSP900GH level transmitter (HART 5)
- Mobrey MSP900SH level transmitter (HART 5)
- Mobrey MSP900FH flow transmitter (HART 5)

Note

- If a Mobrey MSP Series transmitter is connected, refer to the reference manual on the Mobrey brand pages at www.emersonprocess.com for full information about programming the transmitter parameters (e.g. Transmitter Bottom Reference) using the MCU900 Series control unit or other HART-based devices.

E.3 Generic support for HART transmitters

E.3.1 Compatibility between transmitter and control unit

The MCU900 Series control unit is designed to provide an intrinsically safe power supply to power a I.S approved transmitter that is field-mounted in a hazardous area. The control unit provides a nominal 24 Vdc supply.

Communication with the transmitter is HART, provided the transmitter current output is configured in a passive mode to enable the control unit to power the current loop.

The addition of components (both resistive and semiconductor) as part of the I.S certification and HART communication result in the terminal voltage varying with load current. Increasing the load current in the loop results in a decrease in the terminal output voltage of the control unit. Most HART transmitters require a minimum input voltage to work correctly, and for HART communication to function. For example, a Mobrey MSP900GH Ultrasonic Level Transmitter can operate over a voltage range of 12 to 40 Vdc (12 to 30 Vdc for intrinsically safe installations). Consideration must be given to the loop resistance of the cable connecting the transmitter to the controller to ensure sufficient input voltage is available at the transmitter.

Care must be taken in checking compatibility of the control unit when selecting the required HART transmitter. Ensure that the input voltage requirements of the transmitter and the loop resistance are below the limits given in Table E-1 on page 140.

Some Explosion-proof (Exd) rated transmitters have a high input voltage requirement which can result in HART communication failing to function at high loop currents. For example, the Explosion-proof version of the Rosemount 5400 Series transmitter has a minimum input voltage requirement as follows:

- 15.5 Vdc at 21.75 mA
- 20 Vdc at 3.75 mA

The Exd version of Rosemount 5400 Series transmitter would not be suitable for use with the MCU900 Series control unit.

Table E-1 shows the minimum MCU900 terminal output voltage (worst case conditions) for varying load conditions.

Table E-1. Minimum terminal output voltages from control unit

Load current mA	MCU900 terminal voltage Vdc	Maximum loop resistance ohms	
3.6	21.0	2370	Minimum fault current
4.0	20.8	2195	Normal minimum output
20.0	13.9	95	Normal maximum output
21	13.6	50	Maximum o/p fault level

E.3.2 Universal and common practice commands

Support for the **Universal** and **Common Practice** commands of all other HART 5/6/7 transmitters is provided in accordance with HART practice.

Table C-2 on page 132 shows the menu structure and parameters for generic HART 5/6/7 transmitters parameters as seen on a MCU900 Series control unit or other HART-based devices.

Universal commands

- #0 Read unique identifier.
- #1 Read primary variable.
- #2 Read loop current and percent of range.
- #3 Read dynamic variables and loop current.
- #6 Write polling address.
- #7 Read loop configuration.
- #12 Read message.
- #13 Read tag, descriptor, date.
- #14 Read primary variable transducer information.
- #15 Read device information.
- #16 Read final assembly number.
- #17 Write message.

- #18 Write tag, descriptor, date.
- #19 Write final assembly number.
- #20 Read long tag.
- #22 Write long tag.
- #31 Indicates extended command number in data field.
- #38 Reset configuration changed flag.
- #48 Read additional device status.

Common practice commands

- #33 Read device variables.
- #34 Write primary variable damping value.
- #35 Write primary variable range values.
- #36 Set primary variable upper range value.
- #37 Set primary variable lower range value.
- #40 Enter/exit fixed current mode.
- #41 Perform self test.
- #42 Perform device reset.
- #43 Set primary variable zero.
- #44 Write primary variable units.
- #45 Trim loop current zero.
- #46 Trim loop current gain.
- #47 Write primary variable transfer function.
- #50 Read dynamic variable assignments.
- #51 Write dynamic variable assignments.
- #59 Write number of response preambles.
- #71 Lock device.
- #72 Squawk.
- #76 Read lock device status.
- #79 Write device variable.
- #89 Set real-time clock.
- #90 Read real-tine clock.
- #95 Read device communication statistics.
- #107 Flush delayed responses.
- #109 Burst mode control.

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